SPACE OPERATIONS

Budget Authority (in $ millions)	Actual FY 2011	Estimate FY 2012	FY 2013	Notional FY 2014	FY 2015	FY 2016	FY 2017
FY 2013 President's Budget Request	**5,146.3**	**4,187.0**	**4,013.2**	**4,035.1**	**4,035.1**	**4,035.1**	**4,035.1**
Space Shuttle	1,592.9	556.2	**70.6**	0.0	0.0	0.0	0.0
International Space Station (ISS)	2,713.6	2,829.9	**3,007.6**	3,177.6	3,170.9	3,212.8	3,234.3
Space and Flight Support (SFS)	839.8	800.9	**935.0**	857.5	864.2	822.3	800.8

SPACE OPERATIONS

FY 2013 BUDGET

Budget Authority (in $ millions)	Actual FY 2011	Estimate FY 2012	FY 2013	Notional FY 2014	FY 2015	FY 2016	FY 2017
FY 2013 President's Budget Request	**5,146.3**	**4,187.0**	**4,013.2**	**4,035.1**	**4,035.1**	**4,035.1**	**4,035.1**
Space Shuttle	1,592.9	556.2	**70.6**	0.0	0.0	0.0	0.0
International Space Station	2,713.6	2,829.9	**3,007.6**	3,177.6	3,170.9	3,212.8	3,234.3
Space and Flight Support (SFS)	839.8	800.9	**935.0**	857.5	864.2	822.3	800.8
Change From FY 2012 Estimate	--	--	**-173.8**				
Percent Change From FY 2012 Estimate	--	--	**-4.2%**				

In May 2011, *Endeavour* delivered the Alpha Magnetic Spectrometer (AMS) and spare parts including two S-band communications antennas, a high-pressure gas tank and additional spare parts for Dextre to ISS. The AMS is a state-of-the-art particle physics detector designed to operate from ISS to search for unusual types of matter to advance knowledge of the universe.

Activity funded from the Space Operations account includes International Space Station (ISS), currently orbiting Earth with a crew of six, and activities related to closing out the Agency's 30-year Space Shuttle Program.

The Space Operations account also provides space services to NASA customers and other partners in the U.S. and throughout the world. It provides safe and reliable access to space, develops and implements future space launch complex upgrades, manages rocket testing capabilities, maintains secure and dependable communications to ground stations and between platforms across the solar system, and provides the necessary training and supports the health and safety of the Nation's astronauts.

EXPLANATION OF MAJOR CHANGES FOR FY 2013

The safe completion of the final Space Shuttle mission marked the end of the program's operational phase and the beginning of significant transition and retirement activities. In addition, the FY 2013 budget includes funding for an additional Tracking and Data Relay Satellite (TDRS)-M to continue space network tracking, data, voice, and video services to NASA, as well as other United States Government missions.

ACHIEVEMENTS IN FY 2011

After a distinguished 30-year career, the Space Shuttle rolled to "wheels stop" in July 2011, marking the end of Space Shuttle operations. With completion of the three missions in 2011, the Space Shuttle

program is focusing on transition, retirement, and disposition of program assets and workforce. NASA looks forward to moving the retired orbiters to museums and science centers across the country to inspire the next generation of explorers.

Completing the assembly and outfitting of the U.S. on-orbit segment of ISS was the crowning achievement of the Space Shuttle's lifetime. ISS now serves as a fully functional, permanently crewed research laboratory and technology test bed, providing a critical stepping stone for exploration and future international cooperation, as well as an invaluable National Laboratory for non-NASA and non-governmental users.

KEY ACHIEVEMENTS PLANNED FOR FY 2013

With assembly of ISS complete, the program will expand efforts to utilize ISS as a National Laboratory for scientific, technological, diplomatic, and educational purposes; advance engineering, technology, and research capabilities on ISS by maximizing ISS research time and accomplishing a minimum of 90 percent of the on-orbit research and technology development objectives; and, in concert with the international partners, maintain a continuous capability to support six crew on ISS. NASA will demonstrate commercial cargo transport systems by completing at least three flights to deliver research and logistics hardware to ISS via U.S. developed cargo delivery systems. The TDRS-K will launch in early FY 2013, while TDRS-L prepares for launch in early FY 2014. In addition, the LSP has four NASA launches planned.

BUDGET EXPLANATION

The FY 2013 request is $4,013.2 million, a $173.8 million decrease from the FY 2012 estimate ($4,187.0 million). The FY 2013 request includes:

- $70.6 million for the Space Shuttle Program, which will complete the transition and retirement of the three orbiters and other personal property associated with the program;
- $3,007.6 million for ISS, to continue operations and maintenance, support scientific research, and acquire crew and cargo transportation; and
- And $935.0 million for Space and Flight Support (SFS), which will maintain and enhance multiple Agency-level capabilities supporting national operations in space.

SPACE OPERATIONS

Themes

SPACE SHUTTLE

With the retirement of the Space Shuttle fleet in FY 2011, the program has shifted focus to transitioning key workforce, technology, facilities, and operational experience to a new generation of human space flight exploration activities. As part of this effort, NASA is assessing the applicability of Space Shuttle property (including main propulsion system elements) to the Space Launch System, which will enable human space exploration beyond low Earth orbit.

INTERNATIONAL SPACE STATION

ISS is an unprecedented technological and political achievement in global human endeavors to conceive, plan, build, operate, and utilize a research platform in space. It is the latest step in humankind's quest to explore and live in space. With on-orbit assembly of ISS completed, including all international partner laboratories and elements, it has developed into a unique research facility capable of unraveling the mysteries of life on Earth. ISS provides a human-tended laboratory in low Earth orbit to conduct multidiscipline research in biology and biotechnology, materials and physical science, technology advancement and development, and research on the effects of long duration space flight on the human body. The results of the research completed on ISS can be applied to various areas of science, enabling us to improve life on this planet and giving us the experience and increased understanding to journey to other worlds.

SPACE AND FLIGHT SUPPORT

SFS is comprised of multiple programs providing Agency-level capabilities that play a critical role in the success of NASA missions and goals. The Space Communications and Navigation (SCaN) program operates NASA's extensive network of terrestrial and orbiting communications nodes and the associated hardware and software needed to pull down the terabytes of data generated by NASA's fleet of crewed vehicles and robotic spacecraft. LSP facilitates access to space by providing leadership, expertise and cost-effective expendable launch vehicle services for NASA missions. The Rocket Propulsion Testing (RPT) program maintains NASA's wide variety of test facilities for use by NASA, other agencies, and commercial partners. The Space Flight and Crew Operations (SFCO) and Crew Health and Safety (CHS) programs ensure that NASA's astronauts are fully prepared to safely carry out current and future missions.

SPACE SHUTTLE

FY 2013 BUDGET

Budget Authority (in $ millions)	Actual FY 2011	Estimate FY 2012	FY 2013	Notional FY 2014	FY 2015	FY 2016	FY 2017
FY 2013 President's Budget Request	**1,592.9**	**556.2**	**70.6**	**0.0**	**0.0**	**0.0**	**0.0**
Change From FY 2012 Estimate	--	--	**-485.6**				
Percent Change From FY 2012 Estimate	--	--	**-87.3%**				

***Atlantis*' engines and solid rocket boosters ignite as it begins to lift off on the STS-135 mission to the International Space Station, the final flight of the Space Shuttle Program. Nearly a million spectators gathered along the beaches, rivers and causeways to watch history in the making.**

Forty years ago, NASA was charged with developing the world first reusable space transportation system, a powerful vehicle with the versatility to revolutionize how people access and operate in near-Earth space. Since 1981, the Space Shuttle has carried more people (over 350) and more cargo (almost four and a half million pounds) on more missions, and more different types of missions, than any other launch system in history. Between 1998 and 2011, NASA applied the Space Shuttle's full capabilities to the mission for which the system was originally conceived and uniquely designed: assembly of a large, advanced research station in low Earth orbit, one that serves as an international research technology test bed to help NASA and its partners learn how humans can live in space and to prepare for further missions beyond low Earth orbit.

In FY 2011, the Space Shuttle flew its final mission, marking the end of the program's operations phase. In FY 2012 and FY 2013, the Space Shuttle Program will enter its final phase, known as transition and retirement. During this phase, NASA will transition key workforce, technology, facilities, and operational experience to a new generation of human spaceflight exploration activities. NASA will disposition property and other capabilities not needed for future missions, though many important assets, such as the Space Shuttle orbiters will be prominently featured in museums across the country, where they can continue to inspire future generations of explorers. Transition and Retirement activities will be completed in FY 2013, with only minor, residual closeout activities expected to extend into FY 2014. Transition and Retirement contributes to the success of the Agency by ensuring that key assets are prepared and ready for transfer to future program users without delay. All excess Space Shuttle property will be dispositioned so that it does not remain behind as a cost burden to NASA's institutions.

SPACE SHUTTLE

EXPLANATION OF MAJOR CHANGES FOR FY 2013

The FY 2012 budget included a one-time payment of $470 million for pension requirements related to close out of the Space Shuttle Program that is not included in FY 2013. The FY 2013 plan also reflects the remaining work to be completed for the transition and retirement phase that the program has been in since flight operations ceased in August 2011.

ACHIEVEMENTS IN FY 2011

In February 2011, *Discovery* launched on mission STS-133, carrying supplies as well as the permanent multi-purpose module, a logistics module that will remain on orbit, expanding ISS's storage volume. In May 2011, *Endeavour* launched on mission STS-134, carrying the Alpha Magnetic Spectrometer and attached it to the ISS truss structure. During the mission, the NASA delivered critical supplies to ISS and recovered and returned to Earth an ammonia coolant pump module that failed on ISS last year. In July 2011, *Atlantis* launched on mission STS-135 carrying more than 9,400 pounds of spare parts, spare equipment and other supplies. With successful completion of the STS-135 mission, NASA celebrated the successes and achievements of the Space Shuttle Program and looked forward to transitioning key workforce, technology facilities, and operational experience to a new generation of human spaceflight activities.

KEY ACHIEVEMENTS PLANNED FOR FY 2013

Following completion of its final missions, the Space Shuttle Program is focusing on transition, retirement, and disposition of program assets. Substantial assets were associated with the Space Shuttle Program, utilizing nearly 1.2 million line items of personal property during the program's operational peak in FY 2010. Approximately 400,000 of these items will be transferred to future exploration programs, with most of the assets (including equipment associated with Space Shuttle propulsion system elements such as the reusable solid rocket motor, solid rocket booster, external tank, and Space Shuttle main engines) to be utilized by the Space Launch System. These transfers are expected to be completed in FY 2012. Space Shuttle property no longer required to support Agency priorities will be excessed in partnership with the General Services Administration under existing authorities. Most property excessing (including processing and delivery of the Space Shuttle orbiters for museum display) will also be completed in FY 2012. In FY 2013, only about two percent of the 1.2 million line items of property will remain to be dispositioned. All other transition and retirement activities (including facility turnovers, archiving records and IT systems, and contract closeouts) are expected to be substantially completed in FY 2013, with the potential for only minor closeout activities continuing into FY 2014.

BUDGET EXPLANATION

The FY 2013 request is $70.6 million. This represents a $485.6 million decrease from the FY 2012 estimate ($556.2 million). The FY 2013 request includes:

SPACE SHUTTLE

- $31.9 million for program integration, which ensures the overall safety and efficiency of Space Shuttle transition and retirement activities, including software support, systems engineering, and business management;
- $24.9 million for flight and ground operations to identify, process, safe, and transfer flight and ground processing assets once they are no longer needed for safe Space Shuttle Program mission execution; and
- $13.8 million for flight hardware, to identify, process, safe, and transfer flight hardware assets.

Projects

PROGRAM INTEGRATION

In FY 2012, the Agency will spend $19 million on program integration and requests $31.9 million in FY 2013. The FY 2013 program integration budget supports Space Shuttle retirement and the efficient and cost-effective transition of assets to other uses. Activities in this area ensure the overall safety and efficiency of Space Shuttle transition and retirement activities, including software support, systems engineering, and business management. Funding also covers severance and retention costs associated with managing the drawdown of the Space Shuttle workforce.

In FY 2011, NASA finalized requirements for all transition and retirement activities, including property disposition, orbiter display preparation and ferry processing, facilities turnover, records management, and archiving of IT systems. Efforts also included coordination with other exploration programs, most notably the Space Launch System, to finalize the lists of assets that have been requested by those programs for future use.

In 2013, the Agency will oversee the final phase of Space Shuttle transition and retirement, including the closeout of all primary Space Shuttle contracts related the following ongoing activities from previous years.

FLIGHT AND GROUND OPERATIONS

In FY 2012, the Agency will spend $40 million on flight and ground operations and requests $24.9 million in FY 2013. The flight and ground operations budget ensures the availability of resources needed to identify, process, safe, and transfer flight and ground processing assets; this effort should wrap up transition and retirement activities in FY 2013. This budget includes funds needed to prepare assets (e.g., Mission Control Center, the launch pads, the Vehicle Assembly Building, and the Launch Control Center) for modification, transfer to other users, or disposal. The mobile launch platforms, the orbiter processing facilities, and landing site hardware no longer needed by NASA will be made safe of hazardous materials and prepared for transfer to other Federal Government users or other disposition.

In FY 2011, NASA continued preparing Space Shuttle Program facilities for transition to future programmatic or institutional use. Following the launch of STS-135, responsibility for launch complex 39A was transitioned to KSC and the Ground Systems Development and Operations (GSDO) for use by NASA and other launch customers. In addition, the Space Shuttle Program transferred Orbiter Processing

SPACE SHUTTLE

Facility 3, the payload control room, and the Space Shuttle main engine shop to KSC management as part of an arrangement with Space Florida to lease those facilities to Boeing for use in processing Boeing's CST-1000 commercial crew vehicle. NASA also nearly completed closeout of the trans-Atlantic abort landing sites in France and Spain.

In 2013, the Agency will complete transfer of all Space Shuttle facilities to ongoing Agency programs, including those facilities (such as the orbiter processing facilities, launch control complex, the vehicle assembly building transfer aisle, the mate de-mate device, and the shuttle landing facility) that were required for orbiter display preparation processing and ferrying since flight operations were completed in 2011.

FLIGHT HARDWARE

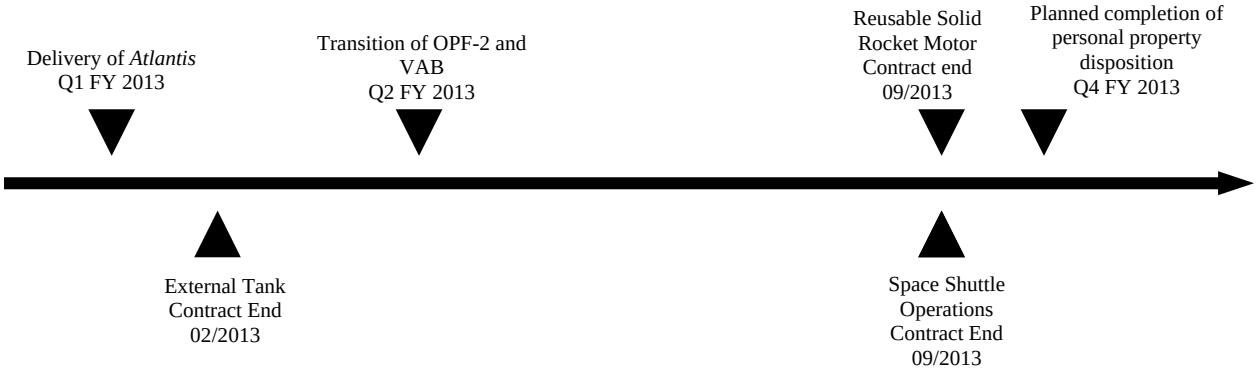
In FY 2012, the Agency will spend $26.8 million on flight hardware and requests $13.8 million in FY 2013. The FY 2013 flight hardware Transition and Retirement budget provides resources needed to identify, process, safe, and transfer flight hardware assets. For orbiters, these costs include safing the vehicles of hazardous materials. For the main engines, these costs also include safing and transportation preparation of current and older engine components that are being made available for alternate use or public display. This budget also covers the disposition costs of the orbiter, Space Shuttle main engine, external tank, and reusable solid rocket motor production tooling capabilities that the Agency will no longer need.

In FY 2011, NASA began the process of preparing major flight assets such as the orbiters and main engines for future use. The *Discovery* orbiter completed post-mission processing activities and began end-state display preparation for museum display. Post-mission processing continued *Endeavour* and *Atlantis* in preparation for the beginning of display preparation processing in FY 2012. Activities also continued for transferring the remaining 15 Space Shuttle main engines and associated ground support equipment to the Space Launch System for use in the first flights of NASA's new exploration launch vehicle.

In 2013, the Agency will complete transition and retirement of all flight hardware asset and production capabilities. All orbiters are on track to be transferred to their final display locations by the first quarter of FY 2013. Display locations are: *Discovery*, to the National Air and Space Museum Steven F. Udvar-Hazy Center, Chantilly, VA; *Endeavour*, to the California Science Center, Los Angeles, CA; *Atlantis*, to the KSC Visitor Center, in Florida. *Enterprise*, currently on display at the National Air and Space Museum Steven F. Udvar-Hazy Center, will be transferred to the Intrepid Sea, Air and Space Museum, in New York, NY.

SPACE SHUTTLE

Program Schedule



Program Management & Commitments

The Space Shuttle Program Manager reports to the Associate Administrator for Human Exploration and Operations at NASA Headquarters.

Project/Element	Provider
Program Integration	Provider: JSC Project Management: JSC NASA Center: JSC Cost Share: None
Flight and Ground Operations	Provider: JSC Project Management: JSC NASA Center: JSC, KSC Cost Share: None
Flight Hardware	Provider: JSC Project Management: JSC NASA Center: JSC, KSC, MSFC, SSC Cost Share: None

SPACE SHUTTLE

Acquisition Strategy

MAJOR CONTRACTS/AWARDS

The Space Shuttle transition and retirement effort in FY 2013 will utilize existing contracts.

Element	Vendor/Provider	Location
Program Integration; Orbiter Processing; Ground Processing	United Space Alliance	Houston, TX
External Tank	Lockheed Martin	Littleton, CO
Space Shuttle Main Engines	Pratt & Whitney Rocketdyne	Canoga Park, CA
Reusable Solid Rocket Motor	Alliant Techsystems Inc. (ATK)	Magna, UT

Program Risks

Risk Statement	Mitigation
If: The funding budgeted to cover the pension shortfall in FY 2012 is insufficient, Then: NASA will be forced to reduce the Shuttle transition and retirement content performed in FY 2012, carrying higher than expected content into FY 2013.	The Space Shuttle transition program is performing a review of remaining content based on projected increases in the pension shortfall for FY 2012 to determine the required cost and schedule for completion of all remaining tasks. The program is also prioritizing remaining tasks to ensure that the highest priority items (orbiter processing, lease terminations, vendor closeouts) would be completed within the current funding projections. If the risk is realized and funding projections remain unchanged, responsibility for some lower priority content, such as disposition of some personal property, may transfer to the Centers after closeout of the Space Shuttle transition program.

INDEPENDENT REVIEWS

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
End-of-year financial audit of unencumbered environmental liability	Pricewaterhouse-Coopers	Oct-11	Assessment of Space Shuttle Program's unecumberd enviromental liability found no issues that would impact the auditor's unqualified opinion of the Agency's financial statements.	Oct-12

INTERNATIONAL SPACE STATION

FY 2013 BUDGET

Budget Authority (in $ millions)	Actual FY 2011	Estimate FY 2012	FY 2013	Notional FY 2014	FY 2015	FY 2016	FY 2017
FY 2013 President's Budget Request	**2,713.6**	**2,829.9**	**3,007.6**	**3,177.6**	**3,170.9**	**3,212.8**	**3,234.3**
ISS Operations and Management	1,681.1	1,418.7	**1,493.5**	1,354.4	1,200.1	1,170.0	1,077.8
ISS Research	175.7	225.5	**229.3**	227.4	231.3	238.3	241.7
Crew and Cargo Transporation	856.8	1,185.7	**1,284.8**	1,595.8	1,739.6	1,804.5	1,914.8
Change From FY 2012 Estimate	--	--	**177.7**				
Percent Change From FY 2012 Estimate	--	--	**6.3%**				

The ISS program's greatest accomplishment is as much a human achievement as it is a technological one. ISS is a collaborative product of five space agencies representing 15 nations. Humans have inhabited ISS continuously since November 2000. Now, at any given time aboard ISS, a large array of experiments are underway to advance of scientific knowledge, develop and test new technologies, and derive Earth applications from new understanding.

ISS is the culmination of efforts of the U.S. and its Canadian, European, Japanese, and Russian partners to work together to construct a highly complex facility that provides an unparalleled capability for human space-based research. ISS includes components built by nations around the globe, launched from four different space centers, and assembled on-orbit by astronauts in over 160 spacewalks. The STS-134 mission marked the completion of major assembly and outfitting activities on ISS, and the subsequent STS-135 mission, flown by *Atlantis* in July 2011, marked the conclusion of the Space Shuttle program after 30 years of flight.

Including its solar arrays, ISS spans the area of a U.S. football field (with end zones) and weighs over 860,000 pounds, not including visiting vehicles. The station orbits the Earth 16 times per day at a speed of 17,500 miles per hour, and an altitude that ranges from 230 to 286 miles. The complex has more livable room than a conventional five-bedroom house, and has two bathrooms, a fitness center, a 360-degree bay window, and hosts state of the art scientific research facilities, which can accommodate a wide array of research disciplines. Since November 2, 2001, when the crew of Expedition 1 docked, ISS has been visited by more than 200 people, and has been continuously crewed for over 11 years.

Beyond being a feat of unparalleled international collaboration, engineering and construction, ISS provides a test bed for learning how to live and work in space over extended periods of time. In addition to external test beds, the three major science laboratories aboard ISS (U.S. Destiny, European Columbus, and Japanese Kibo) enable astronauts to conduct a wide variety of experiments in the unique, microgravity and ultra-vacuum

INTERNATIONAL SPACE STATION

environment of low Earth orbit. ISS supports activities across an array of disciplines, including biology and biotechnology, Earth science, space science, human research, physical and materials science, and technology development.

ISS provides direct research benefits to the public through the National Laboratory, which enables access to the unique microgravity environment and advanced research facilities by U.S. non-NASA agencies, academia, and industry. Additionally, ISS supports NASA's effort to promote the development of a low Earth orbit space economy; the demand for access to ISS provides an initial customer base for providers of commercial crew and cargo systems. Both of these aspects of ISS will help establish and demonstrate the market for research in low Earth orbit beyond NASA requirements.

EXPLANATION OF MAJOR CHANGES FOR FY 2013

Activities that directly support commercial crew and cargo transportation have been moved from the ISS Systems Operations and Maintenance project to the ISS Crew and Cargo Transportation project.

In the FY 2012 budget, crew transportation to ISS beyond spring 2016 was held in the Mission Operations Sustainment program. The FY 2013 budget transfers funding for this activity from Mission Operations Sustainment to ISS and the Missions Operations Sustainment program was eliminated.

ACHIEVEMENTS IN FY 2011

In FY 2011 the ISS program completed final outfitting of the vehicle and conducted 423 scientific investigations.

KEY ACHIEVEMENTS PLANNED FOR FY 2013

In FY 2013 the ISS program will transition management for all National Laboratory payloads to ISS National Laboratory non-profit management organization, the Center for the Advancement of Science in Space (CASIS), and continue upgrades to the research equipment aboard ISS.

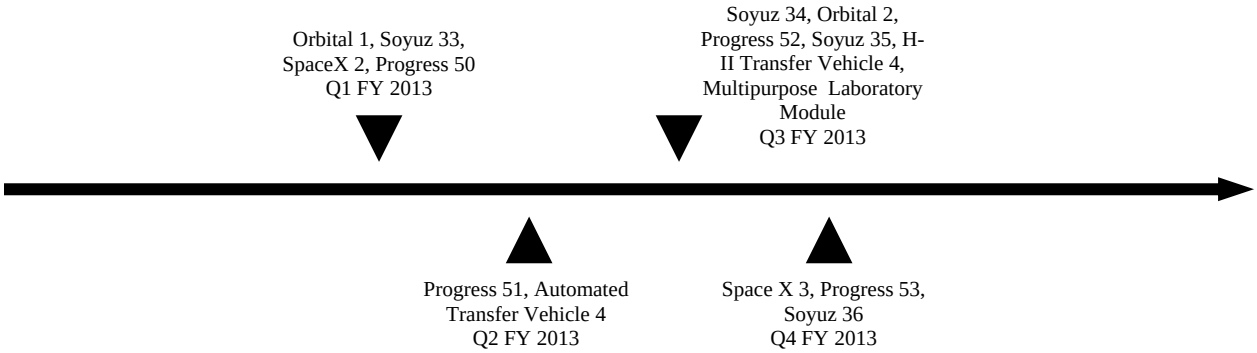
BUDGET EXPLANATION

The FY 2013 request is $3,007.6 million. This represents a $177.7 million increase from the FY 2012 estimate ($2,829.9 million). The FY 2013 request includes:

- $1,493.5 million for ISS Systems Operations and Maintenance, which conducts full-time operations of ISS;
- $229.3 million for ISS Research, which will support direct research benefits to the public arising from unique microgravity environment and advanced research facilities of ISS; and
- $1,284.8 million for ISS Crew and Cargo Transportation, which supports the transportation of crew to ISS as well as the transportation of cargo to ISS including spares, supplies and research.

INTERNATIONAL SPACE STATION

Program Schedule



Acquisition Strategy

MAJOR CONTRACTS/AWARDS

Element	Vendor/Provider	Location
Crew transportation	Roscosmos	Moscow, Russia
Cargo transportation	Orbital	Dulles, VA
Cargo transportation	SpaceX	Hawthorne, CA
ISS National Laboratory Management Entity	CASIS	Tallahassee, FL

INTERNATIONAL SPACE STATION

INDEPENDENT REVIEWS

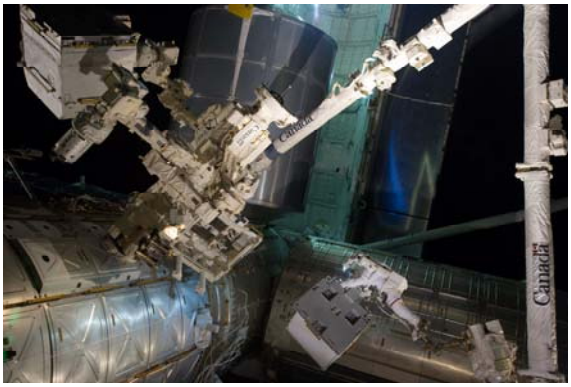
Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Other	ISS Advisory Committee	Sep-11	Assesses ISS operational readiness to support new crew, assesses Russian flight team preparedness to accommodate the Expedition missions, and assesses health and flight readiness of Expedition crew members.	Ongoing
Other	NASA Advisory Council (NAC)	Oct-11	Provides independent guidance for the NASA Administrator. The HEO Committee of the NAC was briefed by the HEO Deputy Associate Administrator on all aspects of Directorate activities, including ISS and commercial resupply services. No formal recommendations were made.	Mar-12
Other	Aeronautics and Space Advisory Board (ASAB)	Sep-11	Provides independent assessments of safety to the NASA Administrator. No recommendations issued relating to ISS.	Jan-12
Other	Program Implementation Review	Aug-08	Provides an independent review of ongoing ISS and Space Shuttle Program operations. The report cited concerns on budget resources and in cargo transportation availability post Shuttle retirement. The review planned for May 2012 will focus on ISS sustainment.	May-12

ISS SYSTEMS OPERATIONS AND MAINTENANCE

Formulation	Development	Operations

FY 2013 BUDGET

Budget Authority (in $ millions)	Actual FY 2011	Estimate FY 2012	FY 2013	Notional FY 2014	FY 2015	FY 2016	FY 2017
FY 2013 President's Budget Request	**1,681.1**	**1,418.7**	**1,493.5**	**1,354.4**	**1,200.1**	**1,170.0**	**1,077.8**
Change From FY 2012 Estimate	--	--	**74.8**				
Percent Change From FY 2012 Estimate	--	--	**5.3%**				



Expedition 28 flight engineers, Mike Fossum (seen lower right) and Ron Garan spent six hours and 31 minutes working outside the station on July 12, 2011. ISS's 58-foot-long Canadarm2 robotic arm maneuvered the spacewalkers around the exterior of the ISS. This 249th spacewalk by U.S. astronauts was the 160th spacewalk in support of station assembly and maintenance.

ISS is a complex facility in low Earth orbit, and maintaining it is a demanding task. Much like a home, ISS requires routine maintenance and can be affected by unexpected failures, though the systems are much more complex and the consequences can be much more dramatic. The ISS crew needs food and other supplies to live, but many of the human necessities taken for granted here on Earth such as water and oxygen require thorough planning to make sure a sufficient and safe supply is available. Besides the difficult job of having to manage unseen systems, the task of maintaining and planning for ISS is further complicated by the international coordination at all levels of the program. The global partnership of space agencies exemplifies meshing cultural differences and political intricacies to plan, coordinate, provide, and operate the complex ISS elements. The program also brings together international flight crews and globally distributed launch, operations, training, engineering, communications networks, as well as scientific research communities. While NASA maintains the lead integrator role for the entire vehicle, each partner has primary authority for managing and operating the hardware and elements they provide.

The ISS Systems Operations and Maintenance project is responsible for safely assembling, operating, and maintaining the ISS vehicle, and providing for continuous human presence on orbit through adequate mission planning and execution, program integration, and cultivation of effective partnerships. This includes continuous mission operations, which involves vehicle monitoring, commanding, and communication with the crew. Sparing analysis and logistics planning ensures that ISS systems continue to function uninterrupted. Crew training and support activity prepares the crew for their stay aboard ISS. The mission integration effort weighs competing priorities and develops a plan to meet program objectives. All aspects of the ISS mission are considered, including scheduling of crew time, visiting vehicle traffic, internal and external stowage, trash management, communication resources, and consumables resupply. The Systems Operations and Maintenance project is also responsible for vehicle

ISS SYSTEMS OPERATIONS AND MAINTENANCE

Formulation	Development	Operations

and program anomaly resolution. Engineers and operators diagnose system failures and develop recovery plans, while program specialists respond to changing program needs and priorities through replanning efforts. All of this is done in concert with safety and mission assurance personnel to ensure that safety is never compromised.

In accordance with the NASA Authorization Act of 2010, NASA is taking actions "necessary to ensure the safe and effective operation, maintenance and maximum utilization of the U.S. segment of ISS through at least September 30, 2020."

EXPLANATION OF MAJOR CHANGES FOR FY 2013

There were no significant ISS changes at the ISS Systems and Operations Maintenance project level. However, activities that directly support commercial crew and cargo transportation have been moved from the ISS Systems Operations and Maintenance project to the ISS Crew and Cargo Transportation project.

ACHIEVEMENTS IN FY 2011

The ISS program completed several milestones in FY 2011, including final outfitting of the ISS vehicle, sustaining operations on-board, and accomplishing all on-orbit research objectives.

Discovery (STS-133) delivered the Italian-built permanent multipurpose module, Leonardo. NASA previously used the module to ferry supplies, equipment, experiments and other cargo to and from ISS via the Space Shuttle's payload bay, and it now provides more space and accommodations for research. During STS-133 and STS-134, ISS also received two more express logistics carriers, unpressurized platforms attached to ISS's exterior that can be used for research. The *Atlantis* (STS-135) mission included delivery of the robotic refueling mission experiment, which will use Canadarm2 on ISS to demonstrate that remote controlled robots can perform satellite refueling and other servicing tasks in orbit following commands sent by controllers on Earth. This capability is expected to reduce costs and risks, and lay the foundation for future robotic servicing missions, which could also include repair and repositioning of orbiting satellites.

Throughout the year, NASA ground teams continued to monitor overall vehicle health and oversee general maintenance and performance of all ISS vehicle systems. These include command and data handling; communication and tracking; crew health care; environmental control and life support; electrical power; extravehicular activity (EVA); extravehicular robotics; flight crew equipment; guidance navigation and control; propulsion, structures and mechanisms; and thermal control. In FY 2011, while some systems experienced anomalies, all systems had acceptable performance with no impacts to ISS operations. Outside of quiescent operations, ISS team supported activities during three shuttle missions, and eleven EVAs, seven from the U.S. joint airlock and four from the Russian segment. Additionally, the ISS program was able to provide all of the resources needed to complete primary mission objectives, including utilization goals.

ISS SYSTEMS OPERATIONS AND MAINTENANCE

Formulation	Development	Operations

One major challenge in ISS systems operations and maintenance came at the end of FY 2011 with the August failure of the Russian Progress 44P resupply ship. The vehicle, which was loaded with fuel and supplies bound for ISS, failed to reach orbit. ISS Systems Operations and Maintenance project personnel were involved in the recovery and replanning effort. NASA technical experts reviewed the failure investigation and mitigation plan prepared by Russian specialists and developed a complete contingency plan. They reviewed and replanned visiting vehicle traffic, revised ISS consumables strategy to account for the lost vehicle, and developed a plan and procedures for de-crewing ISS if needed. Though most failures do not have this significant an impact, this type of organized anomaly response is standard practice for the ISS team, and ensures continuous safe operations for the vehicle and crew.

KEY ACHIEVEMENTS PLANNED FOR FY 2013

In FY 2013, ISS Systems Operations and Maintenance will work to sustain the operation and full use of ISS and expand efforts to utilize the facility as a National Laboratory for scientific, technological, diplomatic, and educational purposes, and to support future objectives in human space exploration. In concert with the international partners, NASA will maintain a continuous six crew capability on ISS by coordinating and managing resources, logistics, systems, and operational procedures. The project will continue to manage requirements and changes in ISS resources, including vehicle traffic, cargo logistics, stowage, and crew time. The team will provide planning and real time support for all ISS activities such as EVAs and visiting vehicles, and support anomaly resolution and failure investigation activities as needed.

The FY 2013 budget supports ISS functionality activities such as proximity operations sensors and monitoring for visiting vehicles, as well as ISS integration of new vehicles. These activities will provide an independent NASA-certified system to track visiting vehicle approaching station, reduce visiting vehicle integration cost and complexity, and support integration activities to demonstrate that commercial crew vehicles can successfully dock with ISS and transport crew.

BUDGET EXPLANATION

The FY 2013 request is $1,493.5 million. This represents a $74.8 million increase from the FY 2012 estimate ($1,418.7 million). The FY 2013 request will provide for continuous operations on ISS, ensure adequate maintenance hardware and supplies to ensure ISS as a facility can be properly maintained and utilized until at least 2020, and pursue additional operational efficiencies to reduce costs and/or increase crew time available for research.

ISS SYSTEMS OPERATIONS AND MAINTENANCE

Formulation	Development	Operations

Project Schedule

The regular rate of cargo delivery (as shown in the ISS program schedule), on a mix of NASA and partner vehicles, will ensure that a nominal operations and maintenance plan can be sustained while allowing for the program to respond to anomalies should they occur during the year. The spacing of the crew rotation flights aboard the Soyuz vehicles will allow the ISS program to maintain a continuous six-crew presence on ISS while ensuring smooth transition between crews.

Project Management & Commitments

Project management of ISS Systems Operations and Maintenance is led by Johnson Space Center (JSC).

Project/Element	Provider	Description
ISS Systems Operations and Maintenance	Provider: JSC Project Management: JSC NASA Center: All Cost Share:	CSA, ESA, JAXA, Roscosmos (Russian Federal Space Agency) support ISS systems operation and maintenance.

Acquisition Strategy

NASA extended the Boeing U.S. on-orbit segment (USOS) sustaining engineering contract until September 30, 2015. It is a cost plus award fee contract that provides the ISS USOS sustaining engineering support, end-to-end subsystem management, and post production hardware support.

MAJOR CONTRACTS/AWARDS

Element	Vendor/Provider	Location
USOS Sustaining Engineering Contract	The Boeing Company	JSC

INDEPENDENT REVIEWS

No reviews in recent years and no reviews planned.

ISS SYSTEMS OPERATIONS AND MAINTENANCE

Formulation	Development	Operations

Project Risks

Risk Statement	Mitigation
If: The Russian Segment cannot provide adequate micro-meteoroid/orbital debris protection, Then: It will expose the on-orbit ISS to greater potential for micro-meteoroid/orbital debris penetration and depressurization contingencies.	The ISS program will implement new shield designs and flight rules to address this issue, including installation of service module orbital debris panels in FY 2012.
If: Astronauts are at higher risk to develop potentially permanent vision impairment, Then: NASA will need to develop mitigation and treatment strategies.	NASA continues to investigate and research the cause of this condition and develop mitigation and treatment strategies. NASA has established a research clinical advisory panel to help address this issue. ISS will obtain new equipment, both on-orbit and lab based, to help identify and evaluate early onset of symptoms. The ISS program is working with the Human Research Program and the Crew Health and Safety program to protect our astronauts. They are coordinating investigations and needed research to resolve this problem for both near- and long-term human space exploration.
If: Difficult-to-replace orbital replacement units fail, Then: ISS operations could be at risk due to the number of extravehicular activities required or the difficult technical nature of the replacement task.	The ISS program has identified orbital replacement units whose failure could pose a risk to vehicle operations. ISS has developed risk assessments for those failures and identified tasks which could be performed ahead of time to better position ISS should a failure occur. ISS is also in the process of developing new tools and systems to perform repairs and recover from failures.

INTERNATIONAL SPACE STATION RESEARCH

Formulation	Development	Operations

FY 2013 BUDGET

Budget Authority (in $ millions)	Actual FY 2011	Estimate FY 2012	FY 2013	Notional FY 2014	FY 2015	FY 2016	FY 2017
FY 2013 President's Budget Request	**175.7**	**225.5**	**229.3**	**227.4**	**231.3**	**238.3**	**241.7**
Change From FY 2012 Estimate	--	--	**3.8**				
Percent Change From FY 2012 Estimate	--	--	**1.7%**				

NASA astronaut Catherine (Cady) Coleman, Expedition 26 flight engineer, performs Pulmonary Function System software calibrations and instrument checks in April 2011, while using the Cycle Ergometer with Vibration Isolation System in the Destiny laboratory of ISS. The software was a collaborative development effort between NASA and ESA for pulmonary physiology instrumentation. The system consists of four modules that make it possible to take a variety of respiratory and cardiovascular measurements.

Having achieved assembly complete in FY 2011, ISS mission priorities have shifted from vehicle assembly to utilization and research. Over the past 11 years, ISS has supported over 1,250 investigations and 1,309 investigators from 63 different countries. Research disciplines include biology and biotechnology, Earth and space science, educational and cultural activities, human research, physical science and technology. Human research is documenting how humans adapt to and recover from long-duration in microgravity, materials test beds are leading to better understandings of materials properties, environmental control and life support systems are achieving 70 to 80 percent water and air recycling, and over 30 million students have participated in human space flight through communications downlinks and interactive experiments with the ISS astronauts. The ISS Research project includes funding for biological and physical research, multi-user systems support (MUSS), National Laboratory enabling activities, and the ISS non-profit management organization.

Currently, the NASA-sponsored ISS research portfolio includes human research and the development of countermeasures to reduce the deleterious effects of microgravity for long-duration exploration missions. ISS crews are conducting human medical research to develop knowledge in the areas of clinical medicine, human physiology, cardiovascular research, bone and muscle health, neurovestibular medicine, diagnostic instruments and sensors, advanced ultrasound, exercise and pharmacological countermeasures, food and nutrition, immunology and infection, exercise systems, and human behavior and performance. While this research is aimed at enabling astronauts to push the boundaries of exploration beyond low Earth orbit, NASA anticipates that many investigations conducted aboard ISS will have application to medicine on Earth, as well. For example, the growing senior population may benefit from experiments in the areas of bone and muscle health, immunology, and from the development of advanced diagnostic systems.

INTERNATIONAL SPACE STATION RESEARCH

Formulation	Development	Operations

In NASA's physical and biological sciences arena, the ISS program is using microgravity conditions to understand the effect of the microgravity environment on fluid physics, combustion science and materials processing, as well as environmental control and fire safety technologies. ISS also provides a test bed for studying, developing, and testing new technologies for use in future exploration missions. Finally, ISS is a platform for observing Earth and supporting educational activities, including observations and investigations that allow students and the public to connect with the ISS mission and inspire students to excel in science, technology, engineering, and mathematics (STEM) academic disciplines.

The MUSS budget provides strategic, tactical, and operational support to all NASA sponsored and non-NASA sponsored payloads, including the five international partners' research payloads. This includes maintenance and operation of the ISS research infrastructure, including research integration, payload engineering, integration, and operations; payload systems support such as maintenance and operation of on-orbit and ground hardware for the payload racks, freezers and middeck lockers; payload software integration; KSC launch site integration; program science integration; and support for national laboratory enabling activities. The MUSS budget also supports multilateral payload planning and integration across the five ISS international partners. Some of the research and technology demonstrations on ISS are funded outside of this ISS Research project budget, but are still supported by the MUSS integration functions.

The MUSS budget supports the operation of on-orbit research facilities, including both internal pressurized facilities in the four partner laboratories and external unpressurized accommodations provided by four of the five international partners.

ISS has numerous unique research facilities:

- Advanced biological research system, biological experiment laboratory, European modular cultivation system, European drawer rack, European physiology module, muscle atrophy research and exercise system;
- Combustion integrated rack; fluids integrated rack; microgravity sciences glove box; materials science research rack-1; fluid science laboratory;
- Two human research facility racks, which include ultrasound, refrigerated centrifuge, portable computer, pulmonary function system, and other facilities;
- Eight EXpedite PRocessing of Experiments to the Space Station (EXPRESS) racks (provide power and communications for experiments housed inside, two also provide vibration isolation).
- Three minus eighty degree laboratory freezer;
- Sun monitoring on the external payload facility of Columbus; Ryutai experiment rack; Saibo experiment rack;
- Window observational research facility;
- European transportation carrier; and
- Twenty-two external payload sites (provide data, power, communications and thermal support).

Under the auspices of an ISS National Laboratory non-profit management organization, the CASIS, NASA will continue to make ISS available as a national resource to promote opportunities for advancing basic and applied research in science and technology to other U.S. government agencies, university based scientists and engineers, and private firms. CASIS will help ensure that ISS's unique capabilities are available to the broadest possible cross-section of the U.S. scientific, technological, and industrial

INTERNATIONAL SPACE STATION RESEARCH

Formulation	Development	Operations

communities, and they will manage research conducted through the National Laboratory. This organization will act as a single entry point for non-NASA users to work efficiently with ISS. It will assist researchers in developing experiments, meeting safety and integration rules, and act as an ombudsman on behalf of researchers. The full transition of these duties from NASA to CASIS is expected to be completed in FY 2013.

EXPLANATION OF MAJOR CHANGES FOR FY 2013

In FY 2013, the Agency will spend $225.5 million on ISS Research and requests $229.3 million in FY 2013. The majority of the increase will be used to issue additional research grants and increase National Laboratory enabling activities, including building an animal habitat. There were no other significant changes to the ISS Research project.

ACHIEVEMENTS IN FY 2011

Ultrasound training methods developed for evaluating medical issues on ISS are being used by the American College of Surgeons to teach ultrasound techniques to surgeons. Additional applications could include diagnosis of injuries and illnesses in remote locations on Earth, including rural areas, disaster areas and the battlefield. ISS nutritional studies have shown that Omega-3 fatty acids counteract bone loss, indicating that diet changes to include more fish may protect bone loss both in space and on Earth. Studies have also identified a loss of Vitamin D as a concern for spaceflight, leading to recommendations for increased intake in astronauts and for all Americans. Technologies used in the Shuttle and ISS robotic arms have led to the world's first MRI compatible image-guided, computer-assisted device specifically designed for neurosurgery. The device is now being used to augment surgeons' skills to perform neurosurgeries that are traditionally considered difficult or impossible.

ISS educational activities examined weaving characteristics of spiders, movement behaviors of fruit flies, and directional plant growth in response to light sources. The 2010-2011"Kids In Micro-G" hands-on design challenge, geared towards students in grades five to eight, was won by two fifth grade girls from San Diego who designed a study called "Attracting Water Drops" to look at static attraction in microgravity and enhanced their understanding of physics in space.

The Agency's own research and technology portfolio includes using ISS to develop technologies that will support future objectives in human space exploration, and during FY 2011, astronauts operated an average of 150 investigations per six month period within the USOS. NASA demonstrated advanced robotics technologies and capabilities in 2011, using the Canadarm2 robotic arm to perform tasks that in previous years would have required astronauts to conduct extensive space walks to complete. NASA also is using ISS as a platform to demonstrate key robotics technologies needed to meet future human space exploration objectives. Robonaut 2, the first humanoid robot in space, launched in February 2011 aboard STS-133. Co-developed with General Motors, the primary job of Robonaut 2 while aboard ISS is to demonstrate how a dexterous robot can manipulate mechanisms in a microgravity environment, operate in the space environment for extended periods of time, assist with ISS tasks, and eventually interact with

INTERNATIONAL SPACE STATION RESEARCH

Formulation	Development	Operations

astronauts. General Motors plans to use the results in future advanced vehicle safety systems and manufacturing plant applications.

Another significant enhancement to the ISS research program in FY 2011 included the delivery of the Alpha Magnetic Spectrometer, which was delivered in May on *Endeavour* (STS-134). It is a state-of-the-art particle physics detector developed by an international team of 56 institutions from 16 countries. At 15,000 pounds, it is the largest scientific payload on ISS. The experiment will use a large permanent magnet to search for antimatter, dark matter, and dark energy to advance knowledge of the universe and lead to a better understanding of the universe's origin.

During FY 2011, NASA took the first steps in transitioning management of the ISS National Lab, which will form a portion of the U.S. utilization activities. NASA awarded a cooperative agreement to an independent non-profit organization with responsibility to further develop national uses of ISS. NASA selected the CASIS, and the ISS program has begun transitioning responsibilities for managing the National Laboratory research and education portfolio including planning and coordinating ground and on-orbit research activities.

Significant operations, process and project improvements were made in support of ISS Research and to enable the National Laboratory, including:

- Investing in numerous on-orbit science hardware improvements and upgrades including developing a internal and external wireless high rate data capability, upgrading the microgravity science glove box to handle biotechnology and life science payloads and high definition/high rate video, doubling the conditioned cargo transportation resupply and return hardware volume efficiency and bio-sample analysis support equipment;
- Restoring protein crystal growth, animal experiment modules, and cell culturing equipment;
- Launching over 11,300 kilogram of research hardware (including over 9,600 kilogram of laboratory facilities and over 1,700 kilogram of research supplies); returning over 1,900 kilogram of research materials, and over 2,060 hours of crew time for research, supporting over 200 investigations across ISS, and 500 investigators from 36 countries; and
- Growing ISS National Laboratory to a total of 33 investigations on ISS, and over 18 agreements with organizations outside NASA.

Specific information on the many ISS experiments conducted during each expedition can be found at http://www.nasa.gov/mission_pages/station/ main/index.html.

KEY ACHIEVEMENTS PLANNED FOR FY 2013

In 2013, NASA will continue to develop its ISS research portfolio in the areas of physical science, human research, biology and biotechnology, technology demonstration and development, and earth and space science, as well as experiments aimed at education and outreach. With funding planned to begin in FY 2013, an upcoming NASA announcement of opportunity for ISS research will offer investigators the chance to assume overall responsibility for research and payload development. NASA hopes that this

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Formulation	Development	Operations

approach will eventually lead to lower cost, faster development, and broader involvement in ISS research by our research universities.

In FY 2012 the Human Exploration and Operations Mission Directorate (HEOMD) established a new division, the Space Life and Physical Sciences Research and Applications Division (SLPSRAD), in which ISS Research will be managed. SLPSRAD activities in ISS Research and in the Human Research Program activities are closely coordinated with the NASA Chief Scientist to ensure that principles of sound research management are upheld. Interaction with the community is a vital component of a healthy research program. SLPSRAD plans to establish a sub-committee of the HEO committee of the NASA Advisory Council that will help NASA coordinate its plans with the research community, to constructively engage the community to optimize the value of the ISS as a research platform, and to plan for the longer term evolution of space biology and physical sciences in human exploration. Working with the subcommittee, NASA will begin planning for the transition from the ISS to the next generation of HEO missions, so that fundamental research requirements and opportunities are identified and developed long before the next major course change is undertaken by HEOMD.

The project will continue to develop and execute process and hardware upgrades started in FY 2011 and FY 2012, establishing enhanced research performance monitoring function to better track and document the benefits of ISS research. The ISS MUSS payload integration function will support an additional 300 on-orbit payload investigations and 500 investigators.

NASA will continue the orderly hand over of management for all National Laboratory payloads to CASIS, which will continue to implement its marketing and communications plan, improve its research pathways model, refine the valuation framework, demonstrate a functioning marketplace, and issue its second research grants solicitation. CASIS plans to complete the first private research project sponsorship agreement with private industry investment in research on ISS in FY 2013.

ISS will continue to support important investigations in such areas as the origin and structure of the universe with the Alpha Magnetic Spectometer-02 experiment, mechanics of the human immune and cardiovascular systems, inertial-capillary flows for key spacecraft systems, biomechanics of treadmill exercise, regenerated amine systems to remove carbon dioxide, laser communications, microbial biofilms, space radiation environment, and satellite servicing.

NASA will complete the flame extinguishment experiment (FLEX)-2 series of droplet combustion experiments and enable JAXA to begin its research in the modular droplet combustion apparatus. The FLEX experiments advance the science of fire safety with experiments on flammability limits of fuels, add to information on combustion kinetics extracted from space measurements of burning droplets, and are being used to improve designs of combustors in turbines.

NASA will begin a series of plant and microbiology experiments using the Biological Research in Canisters device, transported to ISS by commercial cargo carrier. The experiments enabled by this piece of hardware will continue to build on knowledge of how plants respond to gravity as advances in plant science will contribute to engineering food supplies on long-duration missions.

By completing final reports from the boiling experiment facility and capillary channel flow experiment, and communicating those results to fluid and thermal engineering community, NASA will help engineers

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Formulation	Development	Operations

design lighter, more efficient fuel tanks and heat transfer devices (needed to cool systems or produce power) in future space systems.

BUDGET EXPLANATION

The FY 2013 request is $229.3 million. This represents a $3.8 million increase from the FY 2012 estimate ($225.5 million).

Project Schedule

The regular rate of cargo delivery (as shown in the overall ISS program schedule) will ensure that a nominal operations plan can be sustained, allowing for the program to respond to efficiently plan the transportation of research equipment and experiments to and from ISS.

Project Management & Commitments

The HEOMD Associate Administrator has delegated the authority, responsibility, and accountability for managing ISS biological and physical research to the Space, Life and Physical Sciences Research and Applications Division (SLPSRAD) at NASA Headquarters. The division, working closely with the Office of the Chief Scientist, establishes the overall direction and scope, budget, and resource allocation for the project which is then implemented by the NASA Centers and acts as the liaison with the NPO-run National Laboratory. Other ISS Research activities such as MUSS and National Laboratory enabling activities are managed by the ISS Program Office.

Project/Element	Provider	Description
ISS Biological and Physical Research	Provider: HQ Project Management: HQ NASA Center: ARC, GRC, JPL, JSC, MSFC, JSC Cost Share:	In addition to NASA Headquarters, CASIS and ESA provide research direction as part of their respective agreements with NASA.
MUSS (includes National Laboratory enabling activities)	Provider: JSC Project Management: JSC NASA Center: MSFC Cost Share:	CSA, ESA, JAXA, Roscosmos also support research on ISS as part of the ISS relationship.

INTERNATIONAL SPACE STATION RESEARCH

Formulation	Development	Operations

Acquisition Strategy

NASA selected CASIS to manage non-NASA ISS Research activities. The ISS program has begun transitioning responsibilities for managing the National Laboratory research and education portfolio including planning and coordinating ground and on-orbit research activities. This independent non-profit will further develop national uses of ISS. Full transition is expected to be completed in FY 2013.

With the completion of the assembly phase of ISS, NASA faces a critical window for ISS utilization before a potential program end date of 2020. The first priority for available new funding is the development of new flight research for ISS. With a funding line planned to start in 2013, SLPSRAD is preparing an announcement of opportunity for ISS flight experiments to be released in 2012. This announcement of opportunity will provide scientists with the opportunity to propose complete flight experiments, including the development of flight instruments. SLPSRAD's intention is that this opportunity will allow universities to participate in a broader and more meaningful way in flight research, by involving not only their scientists, but also their engineering schools, in senior capstone and master's degree educational opportunities associated with payload design and development.

Ground-based basic research is of course the foundation of a flight science program. The key to a successful re-initiation of a ground-based research program for space biology and physical sciences is obtaining a solid consensus regarding the long-term direction for space biology and physical sciences, particularly beyond the operational lifetime of the ISS. This will be a major focus of discussion with the SLPSRA advisory subcommittee.

MAJOR CONTRACTS/AWARDS

Element	Vendor/Provider	Location
Vehicle Sustaining Engineering Contract	The Boeing Company	Houston, TX
Systems Development and Operations Contract	Teledyne Brown Engineering, Inc.	Huntsville, AL
Huntsville Operations	COLSA Corporation	Huntsville, AL
ISS National Laboratory Management Entity	CASIS	Tallahassee, FL

INTERNATIONAL SPACE STATION RESEARCH

Formulation	Development	Operations

PROJECT RISKS

Risk Statement	Mitigation
If: On orbit anomalies escalate, the amount of crew time devoted to research and experiments may be reduced, Then: The quality and amount of research and experiments may be adversely impacted.	On-orbit research portfolio may require adjustment to favor research with smaller crew requirements.
If: A commercial cargo transportation doesn't become operational, Then: NASA will have to continue to rely on international partners vehicles to provide cargo transportation to ISS.	Commercial partners are making significant progress and are incentivized to work through difficulties in order to receive their milestone payments under the CRS contracts as well as remaining Commercial Orbital Transportation System (COTS) milestones payments. Both ISS and the COTS program support commercial cargo development activities including providing technical assistance and other support to promote success.
If: ISS NPO doesn't find sufficient investors in space research, Then: ISS utilization may be below optimal levels.	Maintain portfolio balance between NASA-sponsored and CASIS-developed utilization while CASIS establishes its operations.

INDEPENDENT REVIEWS

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Quality	Peer Review Panel	Nov-11	Peer review of NASA Research Announcement proposals submitted for ISS research in space biology and physical sciences.	Jul-12

INTERNATIONAL SPACE STATION RESEARCH

Formulation	Development	Operations

Historical Performance

NUMBER OF INVESTIGATIONS CONDUCTED ON ISS (SUMMARY)

Past ISS Investigations	ISS Expeditions 25/26 Sept 2010 - Mar 2011	ISS Expeditions 27/28 Mar 2011 - Oct 2011	ISS Expeditions 0-28 Dec 1998 - Oct 2011
Number of Investigations	182	241	1251
New Investigations	*41*	*87*	--
Completed Investigations	*88*	*92*	*1055*
Number of Investigators with Research	413	449	1309
Countries with ISS Investigations	36	36	63

Current and Future Investigations	ISS Expeditions 29/30 Sept 2011 - Mar 2012	ISS Expeditions 31/32 Mar 2012 - Sept 2012	ISS Expeditions 29-32 Sept 2011 - Sept 2012
Total Investigations	191	215	259
New Investigations	*39*	*60*	*60*
Number of Investigators with Research	449	441	526
Countries with ISS Investigations	28	24	31

ISS CREW AND CARGO TRANSPORTATION

FY 2013 BUDGET

Budget Authority (in $ millions)	Actual FY 2011	Estimate FY 2012	FY 2013	Notional FY 2014	FY 2015	FY 2016	FY 2017
FY 2013 President's Budget Request	**856.8**	**1,185.7**	**1,284.8**	**1,595.8**	**1,739.6**	**1,804.5**	**1,914.8**
Change From FY 2012 Estimate	--	--	**99.1**				
Percent Change From FY 2012 Estimate	--	--	**8.4%**				

A Russian Soyuz spacecraft is shown docked at the ISS (September 2011). A Soyuz space capsule took the first crew to ISS in November 2000, and at least one Soyuz has always been at ISS since then, generally to serve as a lifeboat should the crew need to return to Earth unexpectedly. In addition, a Russian Progress supply vehicle is usually docked at ISS.

Maintaining ISS requires an international fleet of vehicles and launch locations to rotate crewmembers, replenish propellant, provide science experiments, necessary supplies, and maintenance hardware, and dispose of waste. These deliveries sustain a constant supply line crucial to ISS operations. The ISS Crew and Cargo Transportation project supports services to and from ISS, including the acquisition of transportation services provided by international partners and commercial providers. NASA has contracted with Roscosmos to provide crew transportation through crew return in the spring of 2016. The ISS program plans to continue purchasing crew transportation services from Russia as needed until a domestic capability is available. As NASA has testified, some modification of the Iran, North Korea, Syria Non-proliferation Act (INKSNA) provisions will likely be required for the continued operation of ISS and other space programs after 2016. The Administration plans to propose appropriate provisions and looks forward to working with the Congress on their enactment.

On December 23, 2008, NASA awarded commercial resupply services (CRS) contracts to Orbital Sciences Corporation (Orbital) and Space Exploration Technologies (SpaceX) for cargo delivery to ISS, as NASA anticipates that both providers will have operational systems in 2012. NASA has ordered eight CRS flights from Orbital and 12 CRS flights from SpaceX. The FY 2013 budget supports these contracted flights, as well as future flights to provide for cargo transportation through 2016 and beyond, including cargo transportation for National Laboratory research payloads. In addition to the direct transportation costs, ISS Crew and Cargo Transportation funds other work that supports transportation needs, including a system to support crew communications and provide backup capability for the existing cargo providers.

The Commercial Crew program (funded in the Exploration account, see the Commercial Crew section for a detailed justification) is working with industry partners to develop a crew transportation system that will

be available for transporting astronauts to and from ISS, as well as the provision of rescue services, by 2017. Success of this program would end the outsourcing of work to foreign providers.

NASA's efforts to assist in developing U.S. commercial cargo and crew vehicles represents a new way of doing business for the Agency. With this approach, NASA plans to procure domestic crew transportation services to low Earth orbit rather than own and operate government vehicles or procure services from an international partner.

EXPLANATION OF MAJOR CHANGES FOR FY 2013

Activities that directly support commercial crew and cargo transportation have been moved from the ISS Systems Operations and Maintenance project to the ISS Crew and Cargo Transportation project. These activities include the development of a standard common communications interface for visiting vehicles to ISS. Additionally, in the FY 2012 budget, funds for crew transportation to ISS beyond the spring of 2016 were held in the Mission Operations Sustainment program. The FY 2013 budget transfers funding for this activity from Mission Operations Sustainment to ISS and the Missions Operations Sustainment program was eliminated.

ACHIEVEMENTS IN FY 2011

The ISS Crew and Cargo Transportation project budget supported the following Russian Progress launches in FY 2011 providing cargo transportation services to ISS: Progress 41P, Progress 42P, Progress 43P, Progress 44P (vehicle was lost approximately 6.5 minutes after launch), and Progress 45P. These vehicles carried a total of 3,379 pounds of cargo to ISS and provided 4,319 pounds of waste disposal. The Crew and Cargo Transportation project also supported the following Russian Soyuz launches in FY 2011 providing crew transportation services to ISS for six USOS crewmembers: Soyuz 24S, Soyuz 25S, Soyuz 26S, and Soyuz 27S.

In FY 2011, CRS contractors continued to make significant progress towards achieving commercial cargo transportation services. Orbital completed 11 milestones for performance on four Orbital CRS flights and one demonstration flight, SpaceX completed ten milestones for performance on four flights and one COTS demonstration flight.

KEY ACHIEVEMENTS PLANNED FOR FY 2013

The ISS Crew and Cargo Transportation project will continue to provide a stable crew flight plan, which includes four Soyuz launches carrying a total of six U.S. on-orbit segment crew members to ISS. It will also continue to provide a stable cargo flight plan which includes CRS flights delivering research and logistics hardware to ISS. Planned Orbital FY 2013 achievements include two flights (Orb-1 and Orb-2) and the following milestone performance on an additional five flights:

- Service module integration and test, and cargo integration review milestones for Orb-3;

ISS CREW AND CARGO TRANSPORTATION

- Vehicle baseline review, mission integration review, and service module integration and test milestones for Orb-4;
- Vehicle baseline review and mission integration review for Orb-5;
- Authority to proceed and vehicle baseline review milestones for Orb-6; and
- Authority to proceed milestone for Orb-7.

Planned SpaceX FY 2013 achievements include two flights (Spx-2 and Spx-3) and the following milestone performance on an additional five flights:

- Cargo integration review milestone for SpX-4;
- Vehicle baseline review and mission integration review for SpX-5;
- Vehicle baseline review for SpX-6;
- Authority to proceed and vehicle baseline review for SpX-7; and
- Authority to proceed for SpX-8.

BUDGET EXPLANATION

The FY 2013 request is $1,284.8 million. This represents a $99.1 million increase from the FY 2012 estimate ($1,185.7 million). The FY 2013 request will support and provide the transportation of crew to ISS, as well as the transportation of cargo to ISS including spares, supplies, and research.

Project Schedule

The regular rate of cargo delivery (see the overall ISS program schedule), on a mix of NASA and partner vehicles, will ensure that a nominal operations and maintenance plan can be sustained while allowing for the program to respond to anomalies should they occur during the year. The spacing of the crew rotation flights aboard the Soyuz vehicles will allow the ISS program to maintain a continuous six-crew presence on ISS while ensuring smooth transition between crews.

ISS CREW AND CARGO TRANSPORTATION

Project Management & Commitments

Project management of ISS Crew and Cargo Transportation is led by JSC.

Project/Element	Provider	Description
ISS crew and cargo transportation	Provider: JSC Project Management: JSC NASA Center: GSFC, KSC Cost Share:	Crew and cargo transportation provided by NASA will be accomplished via the major contracts described below. Crew and Cargo Transportation will be provided by ESA, JAXA, and Roscosmos as part of ISS partnership.

Acquisition Strategy

NASA awarded commercial cargo transportation services to SpaceX and Orbital through the CRS contracts on December 23, 2008. Activities are underway to demonstrate the ability of the CRS vehicle to integrate with ISS. Cargo services are scheduled to begin in 2012, with the current contract running through 2016. NASA has also extended its contract with Roscosmos to purchase crew launches through 2015 and crew rescue and return through early 2016. The ending of this contract coincides with the end of INKSNA waiver.

MAJOR CONTRACTS/AWARDS

Element	Vendor/Provider	Location
Crew transportation	Roscosmos	Moscow, Russia
Cargo transportation	Orbital	Dulles, VA
Cargo transportation	SpaceX	Hawthorne, CA

ISS CREW AND CARGO TRANSPORTATION

Project Risks

Risk Statement	Mitigation
If: CRS does not become operational, Then: NASA will have to continue to rely on international partners vehicles to provide cargo transportation to ISS.	Commercial partners are making significant progress and are incentivized to work through difficulties in order to receive their milestone payments under the CRS contracts as well as remaining COTS milestones payments. Both ISS and the COTS program support commercial cargo development activities including providing technical assistance and other support to promote success.
If: Commercial crew does not become operational, Then: NASA will have to continue to rely on Soyuz vehicles to provide crew transportation to ISS.	Commercial partners are incentivized to work through difficulties in order to avoid losing future funding and NASA technical assistance. In addition, NASA plans to support multiple commercial providers, thereby insulating the Agency in the event a single provider cannot complete its efforts.To reduce provider technical risk, NASA also plans to be fully supportive of the commercial development activities, providing technical assistance, lessons learned, and past experience and knowledge in the area of human spaceflight development and operations.

INDEPENDENT REVIEWS

No ISS Crew and Cargo reviews are planned. All independent reviews are performed at the ISS program level, none at the project level.

ISS CREW AND CARGO TRANSPORTATION

Historical Performance

FLIGHTS TO ISS FROM INCEPTION THROUGH FY 2011

Vehicle	ISS International Partner	Number	Success	Failures
Shuttle	NASA	37	37	0
Soyuz	Roscosmos	27	27	0
Progress	Roscosmos	46	45	1
Proton	Roscosmos	2	2	0
ATV	ESA	2	2	0
HTV	JAXA	2	2	0
Total		**116**	**115**	**1**

**Data includes all assembly, crew transfer, and logistics flights between November 20, 1998 until September 30, 2011; it includes flights to ISS not funded by the ISS budget.*

SPACE AND FLIGHT SUPPORT (SFS)

FY 2013 BUDGET

Budget Authority (in $ millions)	Actual FY 2011	Estimate FY 2012	FY 2013	Notional FY 2014	FY 2015	FY 2016	FY 2017
FY 2013 President's Budget Request	**839.8**	**800.9**	**935.0**	**857.5**	**864.2**	**822.3**	**800.8**
21st Century Space Launch Complex	142.8	123.5	**41.1**	47.0	47.0	47.0	47.0
Space Communications and Navigation	456.7	445.5	**655.6**	570.7	577.3	535.4	513.9
Human Space Flight Operations	112.8	107.3	**111.1**	111.1	111.1	111.1	111.1
Launch Services	83.3	81.0	**81.2**	82.8	82.8	82.8	82.8
Rocket Propulsion Test	44.2	43.6	**45.9**	45.9	45.9	45.9	45.9
Change From FY 2012 Estimate	--	--	**134.1**				
Percent Change From FY 2012 Estimate	--	--	**16.7%**				

SFS is comprised of multiple programs providing Agency-level capabilities that play a critical role in the success of NASA missions and goals. The SCaN program operates NASA's extensive network of terrestrial and orbiting communications nodes and the associated hardware and software needed to pull down the terabytes of data generated by NASA's fleet of crewed vehicles and robotic spacecraft. The LSP facilitates access to space by providing leadership, expertise and cost-effective expendable launch vehicle services for NASA missions. The RPT program maintains NASA's wide variety of test facilities for use by NASA, other agencies, and commercial partners. The Human Space Flight Operations (HSFO) program ensures that NASA's astronauts are fully prepared to safely carry out current and future missions.

BUDGET EXPLANATION

The FY 2013 request is $935.0 million. This represents a $134.1 million increase from the FY 2012 estimate ($800.9 million). The FY 2013 request includes:

- $41.1 million for the 21st Century Space Launch Complex project, with the primary objective of modernizing and transforming KSC the Florida launch and range complex at KSC to support multiple users;
- $655.6 million for SCaN, which provides space communication and navigation capabilities to all missions;
- $111.1 million for HSFO, which supports the U.S. crew rotation on ISS;
- $81.2 million for the LSP, which provides safe, reliable, cost-effective, and on-time launch services for NASA and non-NASA sponsored payloads using expendable launch vehicles; and
- $45.9 million for RPT, which is the principal implementing authority for NASA's rocket propulsion testing.

21ST CENTURY SPACE LAUNCH COMPLEX (21CSLC)

Formulation	Development	Operations

FY 2013 BUDGET

Budget Authority (in $ millions)	Prior	Actual FY 2011	Estimate FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
FY 2013 President's Budget Request	**0.0**	**142.8**	**123.5**	**41.1**	**47.0**	**47.0**	**47.0**	**47.0**
Change From FY 2012 Estimate		--	--	**-82.4**				
Percent Change From FY 2012 Estimate		--	--	**-66.7%**				

At Launch Pad 39B, the three 600-foot-tall lightning towers that form the lightning protection system remain after the pad's deconstruction. The new design will feature a "clean pad" for rockets to come with their own launcher, making it more versatile for future vehicles.

The primary objective of the 21st Century Space Launch Complex (21CSLC) is to modernize and transform the Florida launch and range complex at the KSC to benefit current and future NASA programs, along with other emerging users.

PROJECT PURPOSE

Described as the "launch support and infrastructure modernization program" in the NASA Authorization Act of 2010, 21CSLC will develop and implement shared infrastructure and process improvements to provide more flexible, affordable, and responsive capabilities to a multi-user community. Efforts will focus on the life cycle of a launch complex as an integrated system (from development, activation, operations, and maintenance of capabilities to manufacturing, assembly, test, launch and recovery of flight systems), enabling more efficient and cost effective ground processing, launch, and recovery operations for a variety of users. Related construction of facilities content is included in the justification language for the Construction and Environmental Compliance and Restoration (CECR) account.

EXPLANATION OF PROJECT CHANGES

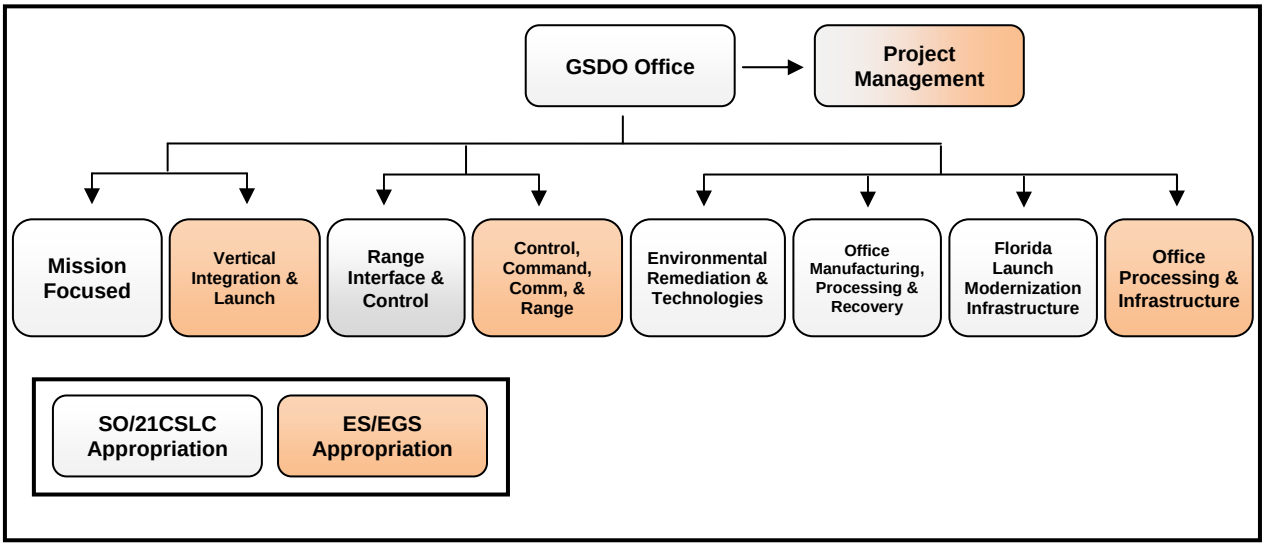
In FY 2011, 21CSLC was established to modernize the launch and range infrastructure at KSC to support multiple customers including NASA, other government agencies, and commercial industry. This program is funded through the Space Operations appropriation. KSC was also develops the necessary ground systems infrastructure to support assembly, test, launch and recovery of associated SLS and Orion MPCV elements, work funded through the Exploration appropriation. To ensure effective and efficient ground systems design that meets the needs of both the SLS/Orion MPCV programs and other users, KSC established the Ground Systems Development and Operations program office. This single-program approach to managing both the 21CSLC content under the Space Operations appropriation and the

21ST CENTURY SPACE LAUNCH COMPLEX (21CSLC)

Formulation	Development	Operations

SLS/Orion MPCV content (called the Exploration Ground Systems or EGS) under the Exploration appropriation provides cost-effective synergy between the various user requirements, while maintaining distinct identification of each element with its appropriation category.

The following diagram shows the break out of the 21CSLC and EGS content as managed under the GSDO program.



Note: *SO = Space Operations account, ES = Exploration account.*

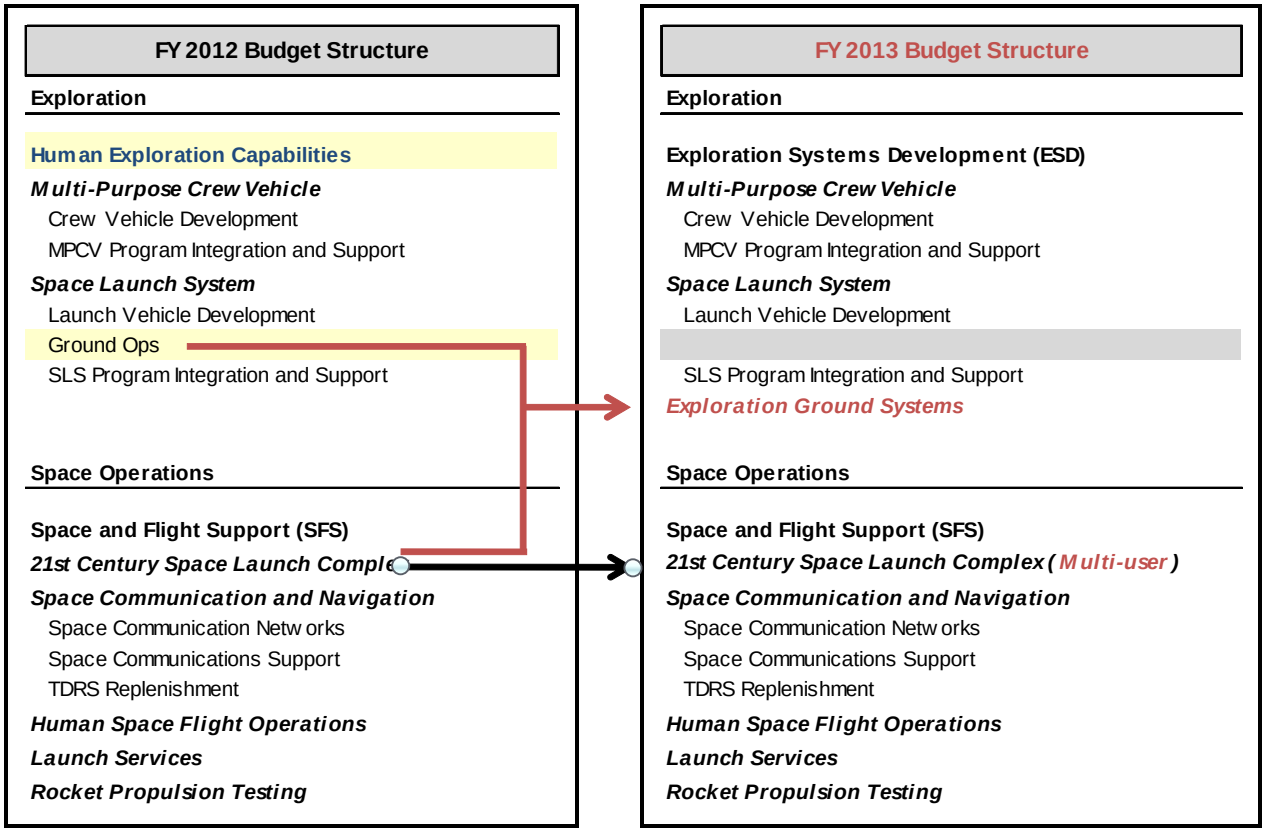
As directed by Congress, Exploration-related work that was included in 21CSLC in previous years has been transferred to the EGS program in this request.

The GSDO program office will be responsible for managing and reporting on the content contained within the two separate appropriations: Exploration Ground Systems (Exploration account), and the multi-user 21st Century Space Launch Complex (Space Operations account). For the purposes of this Congressional Justification and budgetary structure, 21CSLC encompasses the content funded under the Space Operations appropriation. EGS related content is covered in the Exploration account section of this volume.

The following diagram shows the budget trace for 21CSLC and EGS content, between the FY 2012 and FY 2013 budgets.

21ST CENTURY SPACE LAUNCH COMPLEX (21CSLC)

Formulation	Development	Operations



PROJECT PRELIMINARY PARAMETERS

Five specific projects have been identified that meet the stated goals and objectives for 21CSLC.

Florida Launch Modernization Infrastructure

Within this product line, NASA will modernize power, utility and facility systems; IT systems; propellants, gases, and life support systems; and safety and security systems.

In FY 2011, NASA made significant progress to ensure that IT communication would be ready to support Firing Room-1 launch control system demolition activities. In addition, NASA initiated assessments to investigate current conditions and smart modifications for facilities such as the converter compressor facility; cryogenic, high pressure facilities; hypergolic facilities; and upgrades to the industrial area chiller plant.

In FY 2013, NASA will perform crawlerway upgrades to repair the degradation of base material and surface rocks, modifications at the launch equipment test facility improving the hydraulic systems to simulate launch conditions for the SLS vehicle, and developing test fixtures for validating the structural

Formulation	Development	Operations

capability of hold down posts for securing the SLS launch vehicle to the launch pad. Security systems will be upgraded to bring them up-to-date with current technology such as digital imaging, utilizing newly installed connectivity.

Environmental Remediation and Technologies

Within this product line, NASA will address energy conservation/reduction; environmental planning; enhanced remediation; regulatory requirements; sustainability; natural resource mitigation; and environmental research, including materials replacement and technology development.

In FY 2011, NASA performed facility condition studies to develop a plan for upgrading lighting and temperature controls. Additionally, NASA performed studies to determine the most cost effective approach to upgrade or replace waste management facility and develop an oily wastewater facility.

In FY 2013, NASA will execute temperature and lighting upgrades in heritage facilities to reduce utility costs, construct waste facilities for oily wastewater and other hazardous materials, and perform studies and tests to develop effective environmentally friendly coatings for launch equipment and chemical treatments to neutralize hypergolic fuels to an inert state.

Offline Manufacturing, Processing and Recovery Systems

Within this product line, NASA will complete work associated with payload processing; manufacturing; laboratory/testing; servicing/hazardous operations; and recovery.

In FY 2011, NASA completed validation of new chillers for the Multi-Payload Processing Facility phase 1 heating, venting, and air conditioning modifications.

In FY 2013, NASA will be executing the second phase of construction for the facility. In addition, NASA will upgrade the water deluge and containment system, and security systems to allow for hazardous processing of Government or commercial spacecraft or payloads, including the Orion MPCV.

Range Interface and Control Services

Within this product line, NASA will complete work to enhance future capability for command and control; weather; telemetry and tracking; communications; and customer interface systems.

In FY 2011, NASA initiated the range modernization study at KSC, which was a joint USAF/NASA upgrade initiative to improve range monitoring and control capabilities. This included initiation of the future state definition study, a concept to develop a future state strategic vision for an integrated NASA and USAF range architecture. This architecture identifies point of departures from USAF range assets, NASA's current and future mission assets, concept of range operations, and range architectures mapped to USAF current and future state systems.

In FY 2013, NASA will upgrade the radio frequency testing station within the vehicle assembly building at KSC. Additionally, strategic investments in joint NASA/USAF future state roadmap will be initiated following completion of the future state definition study.

21ST CENTURY SPACE LAUNCH COMPLEX (21CSLC)

Formulation	Development	Operations

The Crawler-Transporter (CT) at KSC is being modified to transport a variety of vehicles between the Vehicle Assembly Building and Launch Complex 39. The CT will receive steel stiffeners and braces to increase its load capacity from about 12 million to 18 million pounds and extend its service life another 20 years. The CT weighs about 6 million pounds by itself. Other upgrades include the CT's engines, jack, and the system that keeps rockets level during the trip to the launch pad and up the incline to the pad surface.

Mission Focused Modernization

Within this product line, NASA will complete work associated with vehicle integration and launch; horizontal takeoff, horizontal landing; and vertical takeoff, vertical landing.

In FY 2011, NASA initiated studies and designs at launch complex 39B for a multi-use emergency egress systems, RP-1 servicing capability and environmental control system. Modifications and upgrades were initiated to the Pad infrastructure, cryogenic systems and water systems. In addition, NASA initiated studies and designs for mobile launcher umbilical systems and access arms, and also began removing ground support equipment items from an existing Shuttle mobile launcher platform for reuse on the new mobile launcher. The crawler transporter life extension and modifications were started to allow the crawler transporter to remain operational for the life of the SLS program and to increase the capacity to support planned future use. A multi-use platform modernization study for the VAB was initiated to explore options for platforms that accommodate multiple vehicle configurations. NASA studied options for converting the Shuttle Landing Facility to a multi-use launch facility for horizontal takeoff, horizontal landing use.

In FY 2013, NASA will continue work in the Launch Complex 39 area to enable future customers, including upgrading the associated ground systems equipment, mobile launcher platform, and crawler transporter.

ACHIEVEMENTS IN FY 2011

In FY 2011, NASA completed several 21CSLC studies that informed plans for the future use of facilities at KSC by NASA launch programs, as well as potential commercial and other government users. These studies include adjustable platform for the Vehicle Assembly Building (VAB) integration high bays for a variety of launch vehicles, crawlerway and crawler transporter capabilities to support the transport of different launch vehicles between the VAB and launch pad 39-B. Development work included the fabrication of a propellant heat exchanger for use on the mobile launcher.

KEY ACHIEVEMENTS PLANNED FOR FY 2013

In FY 2013, NASA will continue to establish and develop 21CSLC partnerships aimed at understanding government and commercial ground processing, launch and range infrastructure requirements, while implementing the modifications identified during the FY 2011 initiated studies. Specifically, the VAB chilled/hot water pipe replacement design and the upgrade to the KSC uninterruptable power systems

21ST CENTURY SPACE LAUNCH COMPLEX (21CSLC)

Formulation	Development	Operations

design will be completed in FY 2013. Designs for the upgrade of the critical systems at the VAB Utility Annex will also be completed in the third quarter of the year. In addition, NASA will pursue opportunities to partner or leverage investments for modernization activities to support safer and more efficient launch operations, enhancing payload processing capabilities, facilitate appropriate private sector activities, operations environmental remediation, and supporting the modernization of the launch range capabilities.

BUDGET EXPLANATION

The FY 2013 request is $41.1 million. This represents a $82.4 million decrease from the FY 2012 estimate ($123.5 million), resulting from the transfer of content to the EGS program in Exploration. Budget requests for FY 2013 programmatic construction of facilities associated with this program are included in the CECR section. Funds associated with outyear estimates for programmatic construction remain in programmatic accounts.

ESTIMATED PROJECT SCHEDULE

As a focused set of infrastructure investments, 21CSLC is not required by NASA policy to be managed to the same programmatic milestones as spacecraft projects. R&D investment in 21CSLC will be completed no later than the end of FY 2017.

21ST CENTURY SPACE LAUNCH COMPLEX (21CSLC)

Formulation	Development	Operations

PROJECT MANAGEMENT & COMMITMENTS

The GSDO Program Office develops the necessary infrastructure to support assembly, test, launch and recovery of associated SLS and Orion MPCV elements, and to modernize the launch and range infrastructure at KSC to support multiple customers including NASA, other government agencies, and commercial industry. This single-program approach to managing both the 21CSLC content under the Space Operations appropriation, and the EGS content under the Exploration appropriation, provides cost-effective synergy between the various user requirements, while maintaining distinct identification of each element with its appropriation. The GSDO Program Manager is responsible and accountable for the 21CSLC content in conformance with the governing programmatic and institutional authority requirements documented in NPD 1000.0A.

Project/Element	Provider	Description	FY 2012 PB	FY 2013 PB
Florida Launch Modernization Infrastructure	Provider: 21CSLC Project Management: GSDO Program Office NASA Center: KSC Cost Share: N/A	Manages and executes infrastructure revitalization. This revitalization includes power, utility, and facility systems, propellant and gas systems, IT systems, fire protection security and emergency upgrades and repairs, and transportation systems.	N/A	Realignment of SLS/MPCV content from 21CSLC to EGS and CECR
Environmental Remediation and Technologies	Provider: 21CSLC Project Management: GSDO Program Office NASA Center: KSC Cost Share: N/A	Manages and executes environmental activities. The activities include planning, conservation, remediation, regulation and reclamation implementation, natural resource management, and research and development of sustainable waste management and consumables.	N/A	Realignment of SLS/MPCV content from 21CSLC to EGS and CECR

21ST CENTURY SPACE LAUNCH COMPLEX (21CSLC)

Formulation	Development	Operations

Project/Element	Provider	Description	FY 2012 PB	FY 2013 PB R T
Offline Manufacturing, Processing & Recovery Systems	Provider: 21CSLC Project Management: GSDO Program Office NASA Center: KSC Cost Share: N/A	Manages and executes spacecraft, launch vehicle, and landing and recovery activities. This includes development, maintenance, and operation of servicing and de-servicing facilities and equipment. It also includes the procedure development and personnel to perform the operations associated with the facilities, equipment, and mission.	N/A	Realignment of SLS/MPCV content from 21CSLC to EGS
Range Interface & Control Services	Provider: 21CSLC Project Management: GSDO Program Office NASA Center: KSC Cost Share: N/A	Range interface and control systems capability at KSC and at CCAFS. This includes work to improve sustainability, and operations and maintenance of range safety systems, optical systems, weather systems, and related tools and processes. It provides for development of advanced ground systems maintenance capabilities to include health management systems such as fault isolation recovery and functional fault models.	N/A	Realignment of SLS/MPCV content from 21CSLC to EGS
Mission Focused Modernization	Provider: 21CSLC Project Management: GSDO Program Office NASA Center: KSC Cost Share: N/A	Multi-user facility capabilities to support the multiple vehicles that are processed and launched in the horizontal or vertical configuration.	N/A	Realignment of SLS/MPCV content from 21CSLC to EGS

21ST CENTURY SPACE LAUNCH COMPLEX (21CSLC)

Formulation	Development	Operations

PROJECT RISKS

The most visible risk in this initiative is the requirements definition process for the vehicles that will drive requirements for developing the launchpad Emergency Egress System, which transports crew from the launch pad to a safe location in the event of an emergency. This issue could impact the near-term use of the Florida range.

Risk Statement	Mitigation
If: User vehicles are not compatible with the Emergency Egress System, Then: Such vehicles will be unable to use the range until adaptations can be made to either the vehicle or the Emergency Egress System.	GSDO is benchmarking other human spaceflight programs for optimal solutions so that the Emergency Egress System is viable to a multitude of stakeholders.

Acquisition Strategy

MAJOR CONTRACTS/AWARDS

21CSLC is managed by the GSDO Program Manager and will encompass projects with varying content and sizes. Many of these are consistent with the type of architecture and engineering, construction, and programmatic support available within the scope of existing center and program support contracts. Should the projects size or scope fall outside the scope of existing Center capabilities, then competitively bid firm fixed contracts will be used.

Element	Vendor/Provider	Location
Jacking, equalization and leveling cylinder, roller bearing (crawler transporter)	QinetiQ	McLean, VA
Pad B Infrastructure Repairs and Water Tank Repairs	Rush Construction Inc.	Titusville, FL
Pad B Elevator and Cryo Systems Refurbishment	Ivey's Construction Inc.	Merritt Island, FL
VAB Cable Removal	United Space Alliance	Houston, TX
VAB Cable Removal	Abacus Technology	Chevy Chase, MD

21ST CENTURY SPACE LAUNCH COMPLEX (21CSLC)

Formulation	Development	Operations

INDEPENDENT REVIEWS

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Other	NASA Advisory Council	Jul-10	Provided independent guidance to the NASA Administrator. No formal recommendations were included	TBD

SPACE COMMUNICATIONS AND NAVIGATION (SCAN)

FY 2013 BUDGET

Budget Authority (in $ millions)	Actual FY 2011	Estimate FY 2012	FY 2013	Notional FY 2014	FY 2015	FY 2016	FY 2017
FY 2013 President's Budget Request	**456.7**	**445.5**	**655.6**	**570.7**	**577.3**	**535.4**	**513.9**
Space Communications Networks	347.8	364.2	**440.3**	423.9	432.9	435.1	437.0
**Space Network Ground Systems Sust.*	*22.9*	*53.6*	***104.4***	*91.6*	*99.5*	*99.5*	*99.6*
Tracking and Data Relay Satellite Replenishment	16.9	15.2	**137.1**	67.2	73.0	28.6	2.6
Space Communications Support	92.0	66.0	**78.2**	79.5	71.5	71.8	74.3
Change From FY 2012 Estimate	--	--	**210.1**				
Percent Change From FY 2012 Estimate	--	--	**47.2%**				

Note: **The amounts shown for the Space Communications Networks project include funding for Space Network Ground Segment Sustainment, which is described in more detail in a following section.*

In support of all NASA's space missions, SCaN coordinates multiple space communications networks and provides network support functions to regulate, maintain, and grow NASA's space communications and navigation capabilities. SCaN programs and activities are also national assets that serve a wide range of customers.

The Space Communications and Navigation (SCaN) program provides the crucial communications and navigation services that all NASA space missions require for success. SCaN uses NASA's communications networks to supply vital links for customer missions. These links retrieve science and spacecraft health data, upload commands, and transfer data to individual mission control centers. Navigation services accurately determine where a satellite is and where it is going, so course changes can be planned and spacecraft located for the next communications opportunity.

Without SCaN's services, these satellites could not transmit their data to Earth or be commanded or controlled. Providing these mission-critical services requires systems of high-quality hardware and software on both the spacecraft and ground facilities. A communications or navigation failure, on the spacecraft or in SCaN systems, could result in complete loss of a mission. Without SCaN's services, space hardware worth tens of billions of dollars would be little more than orbital debris. In addition, SCaN leads NASA technology activities to assure future communications and navigation capabilities for ground systems and customer spacecraft.

Today's spacecraft are increasingly powerful, complex, and capable of acquiring and processing ever increasing amounts of mission data, but they still need to communicate with Earth and navigate in space. SCaN must also support missions launched over 30 years ago that are still returning valuable science data. SCaN's mission customers range from high altitude balloons at the edge of Earth's atmosphere, through science satellites in low Earth orbit, to the most distant manmade object, Voyager 1,which is at the edge

of the solar system over 11 billion miles from Earth. SCaN also supports ISS, and will provide support to commercial crew providers and NASA's Orion capsule when they launch. SCaN also provides services to foreign, international, and non-NASA U.S. missions on a reimbursable basis.

SCaN works to ensure that customer missions have the communications and navigation services they need at the lowest practical cost to the customer. Customer mission requirements include the mission's orbit, distance from Earth, data rate, and how often communications opportunities occur. SCaN and the customer mission must match technical parameters such as radio frequency, data coding, modulation scheme, polarization, and error correction.

SCaN consists of space communications networks, space network ground systems sustainment, TDRS Replenishment (TDRS-K, L, and M), and space communications support.

SCaN operates three space communications networks to service customer missions. The Space Network communicates with missions in Earth orbit, and provides constant communication with ISS. The Space Network will also support future commercial crew and Orion missions. The near Earth network communicates with suborbital missions and missions in low Earth and highly elliptical orbits. The Deep Space Network communicates with the most distant missions, such as inter-planetary probes. The three networks require maintenance, replenishment, modernization, and capacity expansion to ensure service for existing and planned missions. NASA purchases ground communications links from the NASA integrated services network to move data between SCaN ground stations, NASA Centers, and mission operation and data centers.

The TDRS replenishment efforts (TDRS-K, L, and M) are major components of maintaining Space Network capabilities. NASA is purchasing three third-generation TDRS to replace aging first-generation satellites that are 17 to 24 years old (well past their design lifetimes) and increasingly showing early signs of impending age-related failures. The three third-generation spacecraft will ensure adequate Space Network services to customers into the 2020s.

The Space Network ground systems will replace aging ground hardware and data systems in the network that operate and route customer mission data to and from TDRS.

Space communications support provides several disparate functions to efficiently integrate and plan current and future network capabilities to customer missions while reducing costs. These functions include systems engineering, architecture planning, communications data standards, technology development and test beds, and radio frequency spectrum management. SCaN's challenge is to meet the requirements of all customer missions, while minimizing the dollars and spacecraft assets devoted to communications and navigation.

SPACE OPERATIONS: SPACE AND FLIGHT SUPPORT

SPACE COMMUNICATIONS AND NAVIGATION (SCAN)

EXPLANATION OF MAJOR CHANGES FOR FY 2013

The FY 2013 request includes funding for the TDRS-M project.

ACHIEVEMENTS IN FY 2011

SCaN's major achievements in FY 2011 are the mission-critical communications and navigation services provided to customer missions. SCaN supported ISS, the final three Space Shuttle missions, and over 70 NASA, NOAA, and other U.S. Government orbital missions. SCaN networks provided over 260,000 hours of tracking in more than 220,000 passes.

KEY ACHIEVEMENTS PLANNED FOR FY 2013

SCaN will continue to provide mission-critical communications and navigation services to customer missions in FY 2013. In FY 2013 TDRS-K will complete on-orbit checkout, TDRS-L will prepare for launch, and TDRS-M will complete its Critical Design Review.

BUDGET EXPLANATION

The FY 2013 request is $655.6 million. This represents a $210.1 million increase from the FY 2012 estimate ($445.5 million). The FY 2013 request includes:

- $440.3 million for space communications networks, which will continue providing critical services to customer mission;
- $104.4 million for Space Network Ground Segment Sustainment (SGSS), which is included in the Space Networks budget. SGSS will replace outdated equipment and systems at the Space Network ground terminals with up-to-date and standardized systems;
- $137.1 million for TDRS replenishment, which will maintain Space Network capabilities into the 2020s; and
- $78.2 million for space communications support, to integrate and plan current and future capabilities.

SPACE COMMUNICATIONS NETWORKS

Formulation	Development	Operations

FY 2013 BUDGET

Budget Authority (in $ millions)	Actual FY 2011	Estimate FY 2012	FY 2013	Notional FY 2014	FY 2015	FY 2016	FY 2017
FY 2013 President's Budget Request	**347.8**	**364.2**	**440.3**	**423.9**	**432.9**	**435.1**	**437.0**
Change From FY 2012 Estimate	--	--	**76.1**				
Percent Change From FY 2012 Estimate	--	--	**20.9%**				

Note: *The amounts shown include Space Network Ground Segment Sustainment, which is described in more detail in a following section.*

The 70-meter-wide (230-foot) antenna at Goldstone Deep Space Communications Complex in California's Mojave Desert, has received data and sent commands to deep space missions for over 40 years. In 2010 it underwent a major, delicate "surgery" to extend its useful life another 20 years. The rigorous engineering procedure, managed by JPL, successfully lifted about 9 million pounds of finely tuned scientific instruments a height of about 5 millimeters (0.2 inches) to replace the steel runner, walls and supporting grout of a bearing assembly that enables the antenna to rotate horizontally.

The three Space Communications Networks, the Space Network, Near Earth Network, and Deep Space Network, are the operational heart of NASA's ability to move data and commands between customer spacecraft and Earth. Each network meets different customer requirements for spacecraft orbits, signal strength, and real-time coverage. In addition to day-to-day operations, each network requires maintenance, modernization, and capacity expansion. Also, SCaN procures terrestrial communications services through the NASA Integrated Services Network (NISN) to move data between customer mission ground sites and space network terminals.

Space Network provides continuous global coverage to missions in low Earth orbit as well as launch vehicles. The primary U.S. communications link to ISS, the Space Network also supports ground research in remote locations, such as the South Pole. Managed by the Space Network Project Office at GSFC, the Space Network consists of tracking and data relay satellite system (TDRSS) of communications satellites in geosynchronous orbit, a set of space-to-ground link terminals at White Sands, New Mexico, and the Guam remote ground terminal. Customer spacecraft (or remote locations) communicate with the on-orbit TDRS, which relays signals to and from the ground terminals.

SPACE COMMUNICATIONS NETWORKS

Formulation	Development	Operations

The SGSS effort is replacing outdated equipment and standardizing systems at the space network ground terminals. Space Network Ground Segment Sustainment funding is included in the Space Communications Networks totals shown above, but additional information is provided in a following section. NASA is modernizing the TDRS fleet by purchasing third-generation spacecraft through TDRS replenishment projects: K, L, and M. TDRS replenishment is described in a following section, and funding is not included in Space Communications Networks.

Near Earth Network services missions in low Earth, geosynchronous, lunar, and highly elliptical orbits, as well as certain suborbital launch locations. Near Earth Network NASA-owned, contractor-operated stations are located at White Sands, New Mexico, U.S. McMurdo Antarctic Station, and Wallops Flight Facility, Virginia. Near Earth Network also purchases services from commercial providers in Alaska, Hawaii, Norway, Sweden, Australia, and Chile. The Near Earth Network Project Office at GSFC manages this network.

To meet the future needs of Near Earth Network mission customers, SCaN is evaluating use of Ka-band radio frequencies for future missions. Using Ka-band frequencies would allow higher data rates than X-band frequencies, and reduce congestion on the saturated X-band. SCaN's spectrum management and architecture activities, discussed under space communications support, are assisting this evaluation.

Deep Space Network services missions beyond low Earth orbit, out to the edge of the solar system. Deep Space Network's ground stations are spaced about 120 degrees apart on the globe in Spain, Australia, and California to maintain continuous communications to distant spacecraft as Earth rotates. NASA owns the Deep Space Network stations, and their operations, maintenance, and upgrade are managed by the Deep Space Network Project Office at JPL.

The Deep Space Network Aperture Enhancement effort is modernizing and upgrading the Deep Space Network to enhance capacity, improve flexibility to support customer missions, and reduce operations and maintenance costs. Much of the Deep Space Network hardware has been in operation for over 30 years and has become difficult and costly to maintain. This is true of antenna structures, exotic electronics such as high-power transmitters and cryogenically-cooled low noise amplifiers, and support elements such as backup generators. Non-construction upgrades, such as electronics and computers, are funded by SCaN. Construction efforts use CoF funds appropriated in the CECR account. A list of SCaN CoF projects, including Deep Space Network, is found in the CECR section of this document.

SCaN purchases services from the NISN to move information between the ground stations of the three space communications networks and NASA Centers and customer mission operations, and data centers. NASA's Chief Information Officer manages NISN as a commercial service framework providing point-to-point terrestrial signal transport services and routing for all of NASA, with SCaN as one of many customers.

SPACE COMMUNICATIONS NETWORKS

Formulation	Development	Operations

EXPLANATION OF MAJOR CHANGES FOR FY 2013

There are no significant content changes in the FY 2013 request. The budget increase from FY 2012 to FY 2013 covers increased costs for Deep Space Network overseas operations and loss of Space Network partner reimbursable funding.

ACHIEVEMENTS IN FY 2011

The Space Network was and continues to be the primary U.S. communications link to ISS, as well as 16 NASA, NOAA, and U.S. Government missions. The network also supported three high-altitude balloon missions, 18 expendable launch vehicle missions, and the final three Space Shuttle missions. Through these efforts, the Space Network provided 162,344 tracking passes totaling over 176,000 hours of tracking, and meeting 99.9 percent of customer tracking requests.

Near Earth Network supported over 30 on-orbit science missions, eight expendable launch vehicle missions, and launch and landing of the final three Space Shuttle missions. Near Earth Network N provided 45,219 tracking passes totaling over 900,000 minutes of tracking in FY 2011, and meeting 99.6 Near Earth Network percent of customer tracking requests.

Near Earth Network also completed antenna, electronics, and network upgrades at the Alaska Satellite Facility, McMurdo Ground Station, Wallops Ground Station, and White Sands Ground Station. Upon completion of the last Space Shuttle mission, Near Earth Network closed the Merritt Island Launch Annex and Ponce de Leon orbit tracking stations (both in Florida) and redistributed equipment to other NEN sites and other NASA users.

Deep Space Network provided telecommunications services for 37 spacecraft missions, including ten mission-critical events. These included the EPOXI encounter of the Hartley-2 Comet, the NeXT encounter of the Temple-1 Comet, Mercury orbit insertion for the MESSENGER mission, and launches of the Juno and GRAIL missions. It also supported six major ground observation programs. In all, the network made 15,728 contacts to committed spacecraft for a total of 78,720 hours of tracking, comprising over 99 percent of planned tracking.

Deep Space Network completed service life extension tasks for the three 34-meter high efficiency antennas. To improve ground station reliability, Deep Space Network completed various utility upgrades, including electrical grid improvement, uninterruptible power supplies, emergency generators, and fire detection improvements. In addition, Deep Space Network completed electronics upgrades, including heat exchangers for 20 kilowatt transmitters and maser frequency standards and multiple upgrades to ground data systems and networks. Deep Space Network also began foundation work for new DSS-35 and DSS-36 antennas in Australia.

SPACE COMMUNICATIONS NETWORKS

Formulation	Development	Operations

KEY ACHIEVEMENTS PLANNED FOR FY 2013

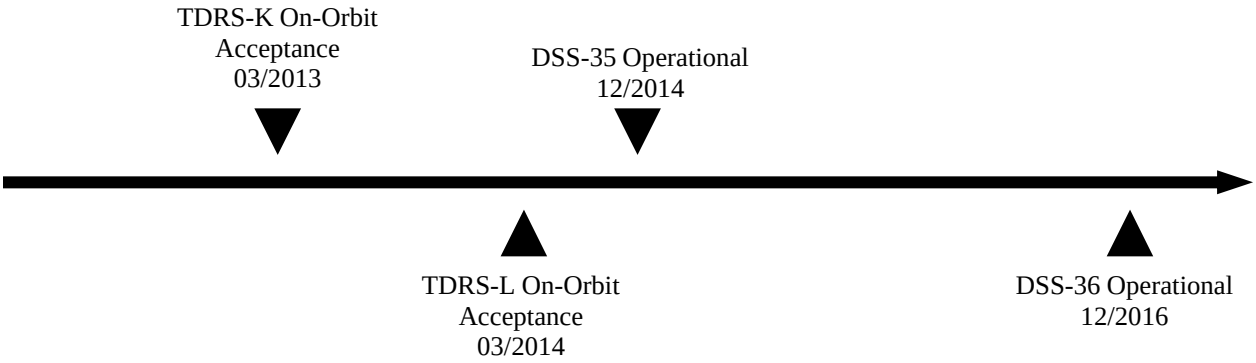
SN will support ISS, launches, and other U.S. Government customers. Activity in the Near Earth Network will support customer missions, as well as upgrading and refurbishment of ground stations and data systems. The Deep Space Network will support over 30 customer missions, including launch and early orbit phase of the Lunar Atmosphere and Dust Environment Explorer, or LADEE spacecraft. At the Deep Space Network ground stations, additional electrical power upgrades will be completed. Electronics upgrades include replacing all beam waveguide antenna controllers; antenna mechanical systems replacements include azimuth tracks on three 34-meter antennas.

TDRS-K will complete on-orbit checkout and become an operational part of the Space Network.

BUDGET EXPLANATION

The FY 2013 request is $440.3 million. This represents an $76.1 million increase from the FY 2012 estimate ($364.2 million).

Project Schedule



SPACE COMMUNICATIONS NETWORKS

Formulation	Development	Operations

Project Management & Commitments

Project/Element	Provider	Description
Space Network	Provider: SN Project Office Project Management: GSFC NASA Center: GSFC Cost Share: non-NASA customers	Communication and navigation services to customer missions.
Near Earth Network	Provider: NEN Project Office Project Management: GSFC NASA Center: GSFC Cost Share: non-NASA customers	Communication and navigation services to customer missions.
Deep Space Network	Provider: DSN Project Office Project Management: JPL NASA Center: JPL Cost Share: non-NASA customers	Communication and navigation services to customer missions.
NASA Integrated Services Network	Provider: NISN (non-SCaN) Project Management: NASA Chief Information Officer NASA Center: NASA Headquarters Cost Share: N/A	SCaN purchases ground communication services from NISN.

Acquisition Strategy

The major acquisitions for the networks are in place. NASA uses reimbursable, international, barter agreements, and competitive procurement where appropriate. Deep Space Network is provided by JPL.

SPACE COMMUNICATIONS NETWORKS

Formulation	Development	Operations

MAJOR CONTRACTS/AWARDS

Element	Vendor/Provider	Location
DSN	JPL	Pasadena, CA
SN Operations	ITT Exelis	McLean, VA
NEN Operations	ITT Exelis	McLean, VA

INDEPENDENT REVIEWS

No independent reviews planned. However, SCaN bases modernization decisions on traffic analysis and reliability models and studies. For the Space Network, TDRS reliability models are continually updated to incorporate on-orbit performance, particularly for the remaining first-generation spacecraft that are past their expected lifetimes and are showing clear and advancing signs of impending age-related failures. SCaN internal analysis has determined that TDRS-M is required to maintain Space Network services, beginning in the 2017 to 2018 timeframe.

SPACE COMMUNICATIONS NETWORKS

Formulation	Development	Operations

Project Risks

Risk Statement	Mitigation
If: Systems fail at higher rates than predicted, Then: Failure could cause service outages and require increased staffing/management attention, maintenance, and spare parts inventories. While the networks have shown impressive reliability and the likelihood of outages are low (but increasing), the consequences are high. Outages during a mission-critical event may result in loss of irreplaceable customer mission data, or even the customer spacecraft. Long-duration outages could reduce network capacity enough to require limiting data downloads from customer spacecraft.	SCaN is balancing and prioritizing near-term operations and maintenance funding against longer-term modernization and replacement efforts while also accepting increased risk of system outages in order to maintain near-term service delivery to customer missions.

SPACE NETWORK GROUND SEGMENT SUSTAINMENT (SGSS)

Formulation	Development	Operations

FY 2013 BUDGET

Budget Authority (in $ millions)	Prior	Actual FY 2011	Estimate FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
FY 2013 President's Budget Request	**26.5**	**22.9**	**53.6**	**104.4**	**91.6**	**99.5**	**99.5**	**99.6**
Change From FY 2012 Estimate		--	--	**50.9**				
Percent Change From FY 2012 Estimate		--	--	**95.1%**				

Fully operational since 1989, the TDRSS network continuously relays data from satellites and spacecraft in low Earth orbit to ground stations in White Sands, New Mexico and in Guam. SGSS modernization will ensure the space network continues to provide global space-to-ground telecommunications and tracking coverage for low Earth orbit and near Earth spaceflight missions, including the Hubble Space Telescope and ISS.

PROJECT PURPOSE

SGSS is replacing outdated equipment and systems at the Space Network ground terminals with up-to-date and standardized systems. Existing ground systems are based on 1980s technology and software; updated systems and equipment will allow the space network to maintain critical communications services to customer missions while reducing operations and maintenance costs.

EXPLANATION OF PROJECT CHANGES

None.

PROJECT PRELIMINARY PARAMETERS

After SGSS completion, each Space Network ground station will be capable of supporting any spacecraft in the TDRSS fleet, whether a first, second, or third-generation satellite. These capabilities will be required to support future space exploration vehicles. The first phase of SGSS is to modernize and integrate space network ground terminals into a unified network. NASA is modernizing the TDRS fleet by purchasing third-generation spacecraft through the TDRS replenishment effort, described separately.

SPACE NETWORK GROUND SEGMENT SUSTAINMENT (SGSS)

Formulation	Development	Operations

ACHIEVEMENTS IN FY 2011

NASA awarded the prime contract for SGSS in FY 2011 and completed the Integrated Baseline Review completed in January 2011. SGSS compiled individual initial requirements into analyzed system-level requirements and successfully completed SRR in July 2011. SGSS is continuing work on detailed requirements, architecture design and interface control documents, and early design leading to a Key Decision Point (KDP)-B review early in FY 2012. The KDP-B review will determine if SGSS is ready to proceed to Phase B, project formulation. Preliminary Design Review (PDR) is planned for later in FY 2012. Without requirements work and reviews in the early phases of the project, later design and development efforts may not operate together correctly or meet the project's needs without costly redesign.

KEY ACHIEVEMENTS PLANNED FOR FY 2013

NASA plans to achieve KDP-C in late FY 2013.

ESTIMATED PROJECT SCHEDULE

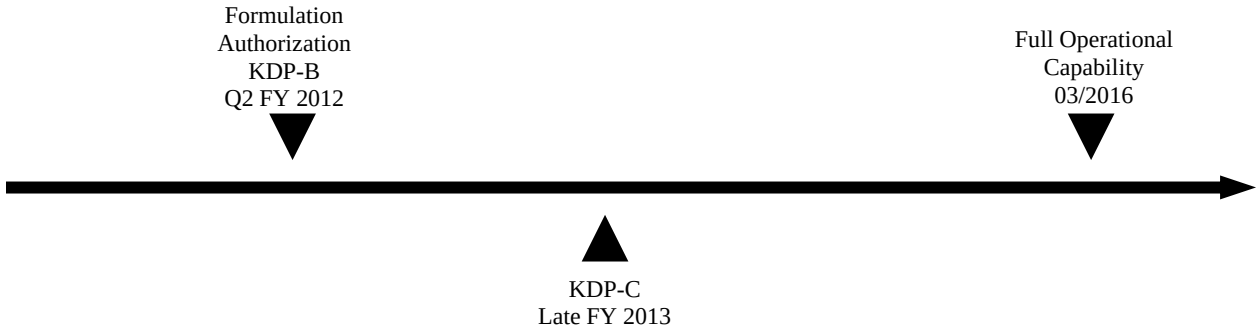
SGSS is in formulation and is being replanned based on the Integrated Baseline Review and SRR findings.

Formulation Milestones	Formulation Agreement Estimate	FY 2013 PB Request Date
Formulation Authorization/	Q2 FY 2012	Q2 FY 2012
KDP-C	Late FY 2013	Late FY 2013
Full Operational Capability	Mar-2016	Mar-2016

SPACE NETWORK GROUND SEGMENT SUSTAINMENT (SGSS)

Formulation	Development	Operations

Project Schedule



Project Management & Commitments

Project/Element	Provider	Description	FY 2012 PB	FY 2013 PB
SGSS	Provider: SGSS Project Office Project Management: GSFC NASA Center: GSFC Cost Share partner: non-NASA Federal customers	Replace outdated ground systems at space network ground terminals	N/A	104.4

SPACE NETWORK GROUND SEGMENT SUSTAINMENT (SGSS)

Formulation	Development	Operations

Project Risks

Risk Statement	Mitigation
If: SGSS products are delayed, Then: The Space Network will continue to use higher-risk, costly-to-operate existing systems and software. The Deep Space Network and Near Earth Network also continue to use costly and aging systems and software.	NASA and the SGSS contractor are revising scope, schedule, and cost estimates based on Independent Baseline Review findings. Revised scope, schedule, and cost will be presented at the KDP-B review in FY 2012. Even with revised scope, schedule, and cost matched to expected budgets, SCaN must carefully manage Space Network Ground Segment Sustainment to deliver products on time so that Space Network, Deep Space Network, and Near Earth Network can benefit from reduced operations and maintenance costs and improved reliability.

Acquisition Strategy

MAJOR CONTRACTS/AWARDS

Element	Vendor	Location
SGSS	General Dynamics C4 Systems	Scottsdale, AZ

INDEPENDENT REVIEWS

Independent reviews will be performed as required by NPR 7120.5. A NASA established Standing Review Board (SRB) to review SGSS project.

SPACE NETWORK GROUND SEGMENT SUSTAINMENT (SGSS)

Formulation	Development	Operations

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
System Requirements Review	SRB	Jul-11	To evaluate whether the program functional and performance requirements are properly formulated and correlated with the Agency and mission directorate strategic objectives; to assess the credibility of the program's estimated budget and schedule. SRR recommended changes to SGSS requirements and scope. SGSS is incorporating those recommendations into a new project baseline of requirements, scope, cost, and schedule for review and decision at KDP-B in second quarter of FY 2012.	N/A
System Definition Review	SRB	N/A	To evaluate the proposed program requirements/ architecture and allocation of requirements to initial projects; to assess the adequacy of project pre-formulation efforts; to determine whether the maturity of the program's definition and associated plans are sufficient to begin implementation.	Q2 FY 2012
Preliminary Design Review	SRB	N/A	To evaluate the completeness/ consistency of the program's preliminary design, including its projects, in meeting all requirements with appropriate margins, acceptable risk and within cost and schedule constraints; and to determine the program's readiness to proceed with the detailed design phase of the program.	Q4 FY 2013

TRACKING AND DATA RELAY SATELLITE REPLENISHMENT (TDRS)

Formulation	Development	Operations

FY 2013 BUDGET

Budget Authority (in $ millions)	Prior	Actual FY 2011	Estimate FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	BTC	LCC Total
FY 2013 President's Budget Request	**394.4**	**16.9**	**15.2**	**137.1**	**67.2**	**73.0**	**28.6**	**2.6**	**0.0**	**735.0**
2012 MPAR Project Cost Estimate	**396.3**	**10.4**	**5.1**	**13.7**						**425.5**
Formulation	241.9									241.9
Development/Implementation	154.4	10.4	5.1	**13.7**						183.6
Operations/close-out										
Change From FY 2012 Estimate		--	--	**121.9**						
Percent Change From FY 2012 Estimate		--	--	**802.0%**						

Note: *While the current Major Program Annual Report project cost estimates are solely for TDRS K/L, TDRS M will be added to the project's scope in FY 2012 pursuant to direction in the FY 2012 Consolidated and Further Continuing Appropriations Act (P.L. 112-55); accordingly, NASA will revise the TDRS baseline cost estimate in the coming months.*

EXPLANATION OF MAJOR CHANGES FOR FY 2013

This budget includes funding for all TDRS replenishment activities. In November 2011, NASA executed the fixed-cost option to acquire TDRS-M; the change from the FY 2012 request reflects the TDRS-M acquisition, rather than an increase to the Major Program Annual Report estimate for TDRS-K and L.

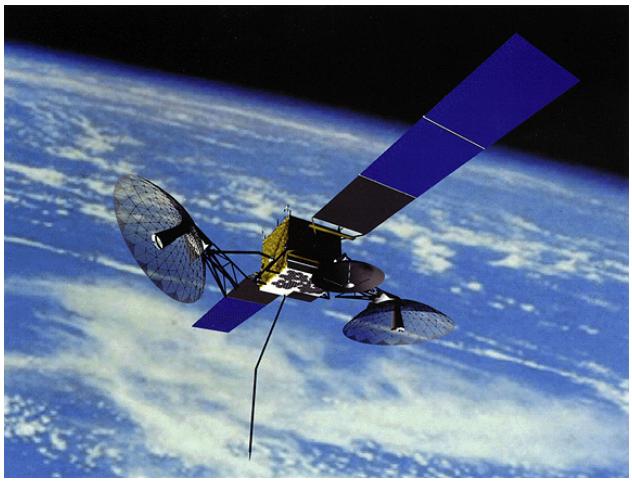
PROJECT PURPOSE

The TDRS fleet supports tracking, data, voice, and video services to the ISS, space and Earth science missions, and other government agency users. The total mission load is predicted to increase, which will require additional satellites to be added to the fleet. Reliability analyses predict that the fleet may be unable to support NASA and other U.S. Government customer missions by FY 2016.

The TDRS replenishment effort is a major component of maintaining NASA's space network capabilities. The Agency is purchasing three third-generation TDRS (K, L, and M) to replace aging first-generation satellites that are 17 to 24 years old, well beyond their designed lifetimes. By early FY 2012, three spacecraft either failed or have been retired, and the remaining three first-generation satellites increasingly showing signs of age-related failure. The three second-generation TDRS are nine to 12 years old. The three third-generation spacecraft will ensure adequate space network services to customers into the 2020s. TDRS replenishment includes modifications to space network ground facilities to support the third-generation satellites.

TRACKING AND DATA RELAY SATELLITE REPLENISHMENT (TDRS)

Formulation	Development	Operations



The Space Network was established in the early 1980s to replace NASA's worldwide network of ground tracking stations. Since then the Space Network has launched 10 TDRS satellites and built three ground stations to accommodate an ever-increasing demand for round the clock service. The second generation TDRS satellite, shown in the artist's conception, was designed, built, and tested to provide service for 11 years in geostationary Earth orbit and maintain health for four additional years of on-orbit storage.

To maintain services to customer missions, NASA began acquiring two third-generation spacecraft, TDRS-K and -L, in FY 2007. TDRS-K is scheduled for launch in December 2012; TDRS-L is scheduled for launch in December 2013. Adding two spacecraft to the TDRSS fleet will ensure continuity of service for NASA and other U.S. government customer missions through at least FY 2016. Maintaining capacity beyond FY 2016 required initiating the TDRS-M acquisition early in FY 2012 for launch in FY 2016; adding TDRS-M will extend capacity into the 2020s.

PROJECT PARAMETERS

TDRSS is a fleet of telecommunications satellites in geosynchronous orbit. The constellation includes both first and second generation satellites, which will eventually be replaced with later generation spacecraft. TDRS and the associated ground stations located at White Sands and Guam comprise the Space Network, which provides communications services for near Earth customer satellites.

ACHIEVEMENTS IN FY 2011

NASA completed the TDRS-K/L Systems Integration Review in July 2011. In September 2011, the TDRS-L bus module integration was completed, and TDRS-K thermal/vacuum testing began in October. The TDRS-M contract option was exercised November 2011.

KEY ACHIEVEMENTS PLANNED FOR FY 2013

TDRS-K will launch in early FY 2013 and complete on-orbit checkout; NASA will prepare TDRS-L for launch in early FY 2014. TDRS-M will undergo Critical Design Review in March 2013.

TRACKING AND DATA RELAY SATELLITE REPLENISHMENT (TDRS)

Formulation	Development	Operations

SCHEDULE COMMITMENTS/KEY MILESTONES

TDRS-K and L completed their Systems Integration Review and are on track for launch in December 2012 and December 2013, respectively.

Development Milestones	Confirmation Baseline Date	FY 2013 PB Request Date
KDP-C	Jul-09	Jul-09
CDR	Feb-10	Feb-10
TDRS-K Launch	Dec-12	Dec-12
TDRS-K on-orbit acceptance	N/A	Launch plus 90 days
TDRS-L Launch	Dec-13	Dec-13
TDRS-L on-orbit acceptance	N/A	Launch plus 90 days

TDRS-M is planned for launch in January 2016, to join the existing TDRS fleet. The following timeline shows the formulation agreement schedule estimates.

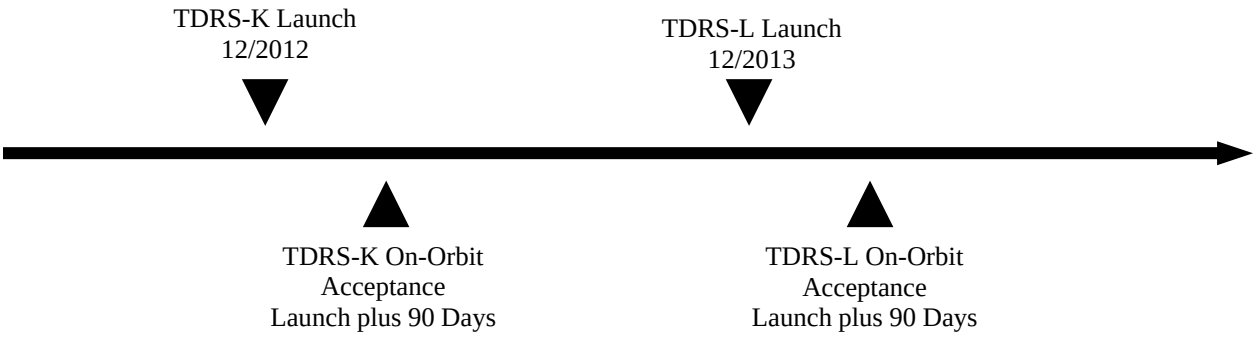
Development Milestones	Formulation Estimate	FY 2013 PB Request Date
Formulation Authorization	Nov-11	Nov-11
Spacecraft Module Design Complete	Jul-12	Jul-12
Critical Design Review	Mar-13	Mar-13
Launch Readiness Date	Jan-16	Jan-16

TRACKING AND DATA RELAY SATELLITE REPLENISHMENT (TDRS)

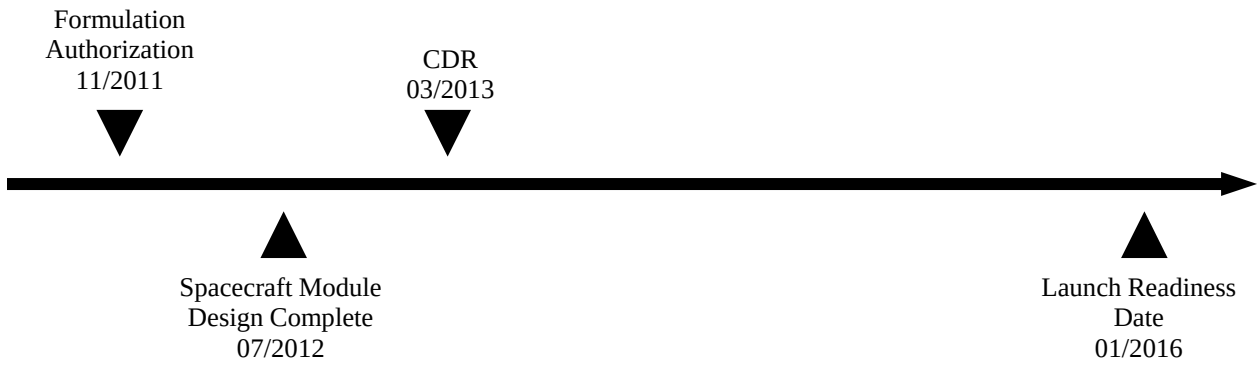
Formulation	Development	Operations

Project Schedule

TDRS-K and L Only



TDRS-M Only



TRACKING AND DATA RELAY SATELLITE REPLENISHMENT (TDRS)

Formulation	Development	Operations

Development Cost and Schedule

Base Year	Base Year Development Cost Estimate ($M)	JCL (%)	Current Year	Current Year Development Cost Estimate ($M)	Cost Change (%)	Key Milestone	Base Year Milestone Date	Current Year Milestone Date	Milestone Change (months)
2010	209.4	75 (CL)	2012	183.6	-12.3%	TDRS-K Launch	Dec-12	Dec-12	None
						TDRS-L Launch	Dec-13	Dec-13	None

Note: *The confidence level estimates reported reflect an evolving process as NASA improves its probabilistic estimation techniques and processes. The estimate above reflects the practices and policies at the time it was developed. Estimates that include combined cost and schedule risks are denoted as joint confidence level; all other confidence levels reflect cost confidence without necessarily factoring the potential impacts of schedule changes on cost. The confidence level estimate (not a JCL) done for TDRS K/L addresses the full partnership; the development cost reflects the NASA portion of project costs.*

While current baseline costs are solely for TDRS K/L, TDRS M will be added to the project's scope in FY 2012 pursuant to direction in the FY 2012 Consolidated and Further Continuing Appropriations Act (P.L. 112-55); accordingly, NASA will revise the TDRS baseline cost estimate in the coming months.

TRACKING AND DATA RELAY SATELLITE REPLENISHMENT (TDRS)

Formulation	Development	Operations

Development Cost Details (in $M)

Element	Base Year Development Cost Estimate	Current Year Development Cost Estimate	Change from Base Year Estimate
TOTAL:	**209.4**	**183.6**	**-25.8**
Aircraft/Spacecraft	56.7	71.7	15
Payloads			
Systems I&T			
Launch Vehicle			
Ground Systems	53.7	53.7	0
Science/Technology			
Other Direct Project Costs	99	58.2	-40.8

NOTE: While current development cost details are solely for TDRS K/L, TDRS M will be added to the project's scope in FY 2012 pursuant to direction in the FY 2012 Consolidated and Further Continuing Appropriations Act (P.L. 112-55); accordingly, NASA will revise the TDRS baseline cost estimate in the coming months.

Project Management & Commitments

The HEOMD Deputy Associate Administrator at NASA Headquarters is project manager.

Project/Element	Provider	Description	FY 2012 PB	FY 2013 PB
TDRS Replenishment	Provider: Boeing Space Systems Project Management: GSFC NASA Center: GSFC Cost Share partner: Other U.S. Government agencies	Acquire third-generation TDRS-K, L, and M to maintain communications services to customer missions into the 2020s.	13.9 K&L only	137.1 K,L&M

TRACKING AND DATA RELAY SATELLITE REPLENISHMENT (TDRS)

Formulation	Development	Operations

Project Risks

The major risk for TDRS replenishment project is a programmatic risk to the Space Network and not a risk within the TDRS replenishment project. The risk is existing operational TDRS may fail earlier than predicted, prior to planned launch of TDRS-K, L, and M, and leave the Space Network with insufficient capacity to service customer missions, even though TDRS-K, L, and M launch as planned.

Risk Statement	Mitigation
If: Existing TDRS fail prior to launch of third-generation TDRS-K, L, and M, Then: Space Network may not have sufficient capacity to support customer missions.	Firm-fixed-price-plus-incentive-fee contract awarded December 2007 to Boeing Satellite Systems, Inc. for TDRS-K and L. TDRS-K will launch in December 2012, and TDRS-L in December 2013. Firm-fixed-price-plus-incentive-fee option for TDRS-M exercised November 2011 for launch in 2016.

Acquisition Strategy

MAJOR CONTRACTS/AWARDS

The major contract for TDRS replenishment was competitively awarded to Boeing Space Systems, Inc., in El Segundo, CA, in December 2007. It is a fixed-price-plus-incentive-fee contract for TDRS-K and L, and includes modifications to Space Network ground systems at White Sands to support these third generation spacecraft. In November 2011, NASA exercised a fixed-price-plus-incentive-fee option on the Boeing contract for TDRS-M.

Element	Vendor	Location
TDRS-K and -L	Boeing	El Segundo, CA
TDRS-M	Boeing	El Segundo, CA
SN Ground System	Boeing	El Segundo, CA

TRACKING AND DATA RELAY SATELLITE REPLENISHMENT (TDRS)

Formulation	Development	Operations

Independent Reviews

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
System Requirements Review	SRB	Jul-08	Evaluated whether program functional and performance requirements were properly formulated and correlated with Agency and mission directorate strategic objectives; and assessed the credibility of the program's estimated budget and schedule. Recommended proceeding to next project phase.	N/A
System Definition Review	SRB	Jul-08	Evaluated proposed program requirements/ architecture and allocation of requirements to initial projects; assessed the adequacy of project pre-formulation efforts; determined that the maturity of the program definition and associated plans were sufficient to begin implementation.	N/A
Preliminary Design Review	SRB	Apr-09	Evaluated completeness/ consistency of the program preliminary design, including its projects, in meeting all requirements with appropriate margins, acceptable risk and within cost and schedule constraints. Determined that the program was ready to proceed with the detailed design phase of the program.	N/A

TRACKING AND DATA RELAY SATELLITE REPLENISHMENT (TDRS)

Formulation	Development	Operations

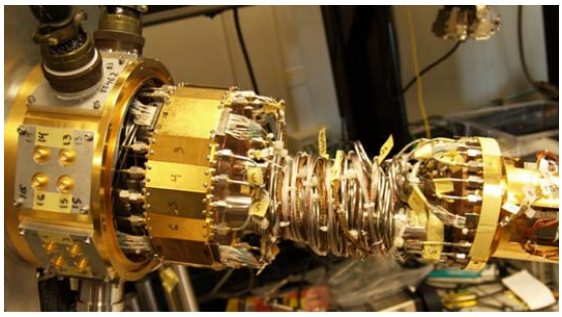
Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Critical Design Review	SRB	Jan-10	Evaluated the integrity of the program integrated design, including its projects and ground systems, to meet mission requirements with appropriate margins and acceptable risk, within cost and schedule constraints. Determined that the integrated design was appropriately mature to continue with the final design and fabrication phase.	N/A

SPACE COMMUNICATIONS SUPPORT (SCS)

Formulation	Development	Operations

FY 2013 BUDGET

Budget Authority (in $ millions)	Actual FY 2011	Estimate FY 2012	FY 2013	Notional FY 2014	FY 2015	FY 2016	FY 2017
FY 2013 President's Budget Request	**92.0**	**66.0**	**78.2**	**79.5**	**71.5**	**71.8**	**74.3**
Change From FY 2012 Estimate	--	--	**12.2**				
Percent Change From FY 2012 Estimate	--	--	**18.5%**				



Current science missions to the Moon and planets are constrained by the amount of data they can communicate back over the long distances. During future exploration missions astronauts will also require high-data-rate communications. Optical systems could provide very-high-rate, very-long-distance communications systems. The Lunar Laser Communications Demonstration will demonstrate optical communications from space, transmitting data at over 600 megabits per second. The instrument's ground receiver (its cryogenic receiver assembly is shown), will be nearly ten times more efficient than any optical receiver demonstrated at these data rates.

While the antennas and satellites of the space communications network are the most visible part of SCaN, successfully providing services to customer missions over the long term requires planning, management, and technology activities grouped in Space Communication Support (SCS). These include architecture and systems planning, standards definition and management, spectrum management, and technology.

Architecture and systems planning, communications data standards, and systems engineering and integration efforts help SCaN meet customer needs at minimum practical cost. Through these efforts, SCS plans system technical characteristics, capacity, and performance, which helps to eliminate duplication across the space communications networks, reduces costly mission-specific requirements in favor of common solutions, and lowers development costs of customer missions by providing "off-the-shelf" communications standards and solutions.

SCaN is NASA's agent for spectrum management and represents the Agency in national and international forums. Spectrum management ensures that necessary radio frequencies remain available to provide communication with all NASA missions and for radio astronomy uses. Spectrum demand for use by commercial wireless devices and their associated networks (e.g., cell phones, WiFi and broadband networks, direct broadcast television) continues to increase, leading to further encroachment of Federal spectrum assignment and increasing the potential for frequency interference. Reallocating additional spectrum for new commercial networks, while maintaining spectrum integrity for existing Federal users (who may not be able to migrate to other frequencies due to hardware limitations or fundamental physics) requires management at the national and international level, and is the only way to ensure appropriate spectrum remains available for current and future NASA uses.

SPACE COMMUNICATIONS SUPPORT (SCS)

Formulation	Development	Operations

SCaN technology efforts have the promise of reducing costs, increasing capacity, and improving performance for future space communications systems. These include disruption-tolerant networks, optical communications (exemplified by the Lunar Laser Communications Demonstration that will fly on the LADEE spacecraft), and the SCaN test bed that will test a software-defined radio on ISS.

EXPLANATION OF MAJOR CHANGES FOR FY 2013

There are no significant changes from the FY 2012 request.

ACHIEVEMENTS IN FY 2011

NASA worked with the National Telecommunications and Information Administration (NTIA) and the Federal Communications Commission (FCC), to manage the spectrum effects of the President's "Unleashing the Wireless Broadband Revolution" initiative to bring wireless broadband to the entire United States. Proposals to move Federal users out of the 1755 to 1850 megahertz band directly affects NASA uses in that band, but more importantly, affects NASA use in the S-band portion of the radio spectrum, as thousands of DoD and other Federal users will be required to migrate to the S-band. NASA, with other Federal agencies, is conducting studies to ensure NASA missions are not adversely affected.

NASA also worked with FCC and NTIA to test and evaluate potential interference from Lightsquared's broadband network on GPS users. Preliminary indications are that Lightsquared's network will interfere with many GPS users, including NASA space-based and terrestrial operations.

Two disruption-tolerant network nodes on ISS were evaluated in operational use and are already demonstrating significant productivity gains in a challenging communications environment.

Final review of the Lunar Laser Communications Demonstration flight sub-system electronics was completed. The optical module completed final qualification testing in preparation for final assembly of the payload.

SCaN completed the test bed thermal vacuum environmental testing and successfully completed the pre-ship review of the software-defined radio. Launch to ISS is expected in the first half of FY 2012.

SPACE COMMUNICATIONS SUPPORT (SCS)

Formulation	Development	Operations

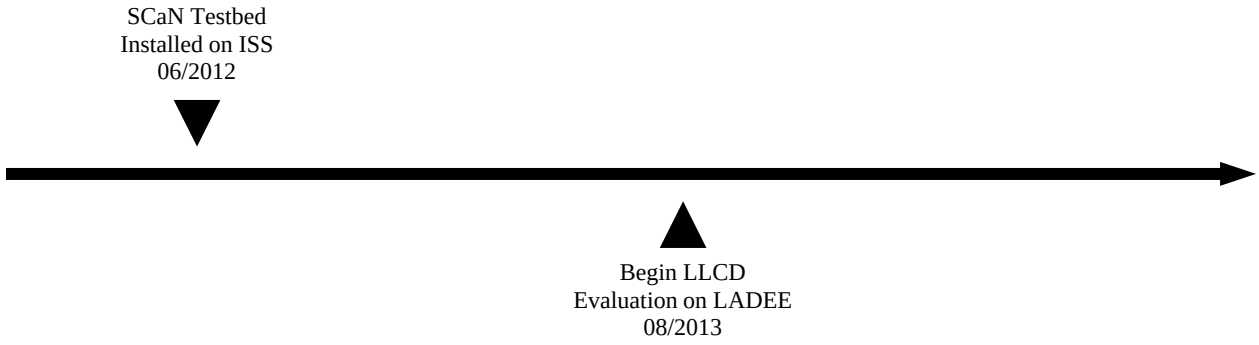
KEY ACHIEVEMENTS PLANNED FOR FY 2013

During FY 2013, SCaN will test and evaluate disruption tolerant networks and the SCaN test bed in an operational environment on ISS, and also test and evaluate the Lunar Laser Communications Demonstration payload on the LADEE mission.

BUDGET EXPLANATION

The FY 2013 request is $78.2 million. This represents a $12.2 million increase from the FY 2012 estimate ($66.0 million).

Project Schedule



Project Management & Commitments

SCS functions are managed by the SCaN Program Office at NASA Headquarters.

SPACE COMMUNICATIONS SUPPORT (SCS)

Formulation	Development	Operations

Acquisition Strategy

SCS functions use multiple, small contracted efforts, most of which are support services functions. There are no major contracts or awards.

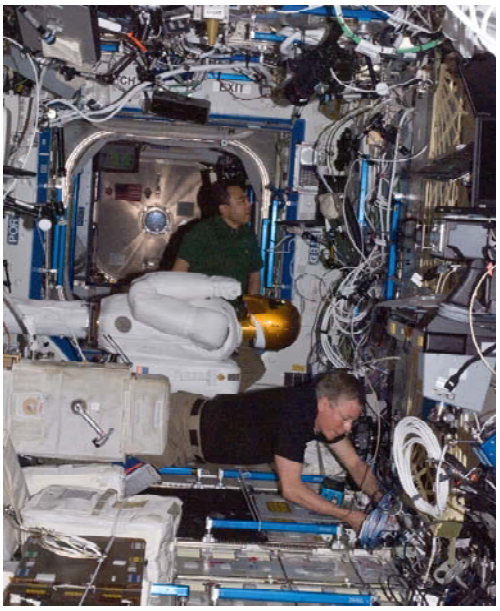
INDEPENDENT REVIEWS

No reviews planned.

HUMAN SPACE FLIGHT OPERATIONS (HSFO)

FY 2013 BUDGET

Budget Authority (in $ millions)	Actual FY 2011	Estimate FY 2012	FY 2013	Notional FY 2014	FY 2015	FY 2016	FY 2017
FY 2013 President's Budget Request	**112.8**	**107.3**	**111.1**	**111.1**	**111.1**	**111.1**	**111.1**
Change From FY 2012 Estimate	--	--	**3.8**				
Percent Change From FY 2012 Estimate	--	--	**3.5%**				



Astronaut Mike Fossum and JAXA crewmember Satoshi Furukawa prepare to power up Robonaut 2 to perform vision tests and check out sensors in the robot's arms. Robonaut 2 was delivered to ISS on STS-133 and is the first humanoid robot in space. Its primary job for now is teaching engineers how dexterous robots behave in space, but through upgrades and advancements, it could one day help spacewalkers make repairs to ISS or perform scientific work.

At the core of human spaceflight is the crew. The physical presence of human beings actively involved in the endeavors of space exploration broadly expands the benefits and experience received by people on Earth. The HSFO budget request supports the readiness and health of the human system, the crew that is so integral to the success of the ISS program and NASA's broader exploration goals and objectives. HSFO is comprised of the Space Flight Crew Operations (SFCO) and Crew Health and Safety (CHS) projects, both of which support the training and care of the astronauts.

SFCO provides overall planning, direction, and management of flight crew operations such as selecting and training astronaut candidates, determining flight crew training and flight crew simulation requirements, recommending specific flight crew assignments, and operating the program support aircraft described below. SFCO maintains the aircraft at a level commensurate with the projected needs of the Agency, the size of astronaut corps, and related aircrew training requirements.

SFCO provides trained astronauts for all of NASA human space flight endeavors and provides astronaut expertise to help resolve operations or development issues within the human space flight programs.

CHS enables healthy and productive crew during all phases of space flight missions, implements comprehensive health care program for astronauts, works to prevent and mitigate negative long-term health consequences of spaceflight, and medically assesses astronaut candidates as part of the selection process.

HUMAN SPACE FLIGHT OPERATIONS (HSFO)

EXPLANATION OF MAJOR CHANGES FOR FY 2013

NASA initiated an astronaut training class selection in FY 2012. The astronaut selection process takes about 18 months followed by a two-year training program to develop necessary skills, knowledge, and expertise.

SFCO is implementing recommendations from a 2011 National Academies study *Preparing for the High Frontier: The Role and Training of NASA Astronauts in the Post-Space Shuttle Era*, relative to the size of NASA's astronaut corps. For example, to plan the future astronaut workforce, NASA intends to re-evaluate attrition rates and commercial crew transport scenarios as well as progress on future programs to determine the size and make up of future astronaut classes to maintain an adequate number of astronauts, with appropriate skills and experience, for assignment to NASA human space flight missions.

ACHIEVEMENTS IN FY 2011

In SFCO, the 2009 astronaut candidate class of nine candidates graduated in November 2011 and is available for flight assignment.

ISS crews completed three successful Expedition launches from Baikonur Cosmodrome in Kazakhstan aboard the Soyuz: Expedition 28 in June 2011; Expedition 27 in December 2010; and Expedition 26 in October 2010.

Additionally, SFCO supported the final three Space Shuttle flights in 2011. STS-133 flew successfully on February 24, 2011 aboard *Discovery*, supporting ISS assembly flight ULF5, which was the orbiter's final flight. STS-134 flew successfully on May 16, 2011 aboard *Endeavour*, which supported ISS assembly flight ULF6, which was the orbiter's final flight. Finally, STS-135 launched successfully on July 8, 2011 aboard *Atlantis* supporting ISS assembly and the deployment of Multi-Purpose Logistics Module, Raffaello. This was the final flight of *Atlantis*, and the final flight of the Space Shuttle Program.

In CHS, NASA activated the picture archiving and capture system component of the electronic medical record system, with the second phase of implementation at the end of September 2011. Phase I included dual energy x-ray absorptiometry (DEXA) scans of bone density. Phase II includes the capture of x-rays and other radiology. The mean time between entry of the order for an x-ray into the electronic medical records systems and the closure of the order is now just 30 minutes. This represents a significant improvement in work flow as well as accurate data capture.

KEY ACHIEVEMENTS PLANNED FOR FY 2013

In SFCO, astronaut training is planned for two crew rotations annually to ISS. Programmatic milestones which the astronaut corps supports are provided in the ISS narrative. NASA plans to select a 2013 astronaut class, with training to begin in June 2013. Assuming one and a half years of astronaut candidate training, they will be eligible for flight assignment in early 2015.

CHS will complete a significant number of visual impairment/intra-cranial pressure studies to aid in the development of mitigation strategies for possible microgravity effects on vision.

HUMAN SPACE FLIGHT OPERATIONS (HSFO)

BUDGET EXPLANATION

The FY 2013 request is $111.1 million. This is a $3.8 million increase from the FY 2012 estimate ($107.3 million).

Projects

SPACE FLIGHT CREW OPERATIONS (SFCO)

SFCO will continue to support aircraft maintenance and operations and also provide trained astronauts for all of NASA human space flight endeavors along with expertise to help resolve operations or development issues. Specific aircraft supported at Ellington Field include the fleet of 16 T-38s, a B-377 Super Guppy Large Cargo Transport, WB-57 High Altitude Research Aircraft, C-9 for Reduced Gravity Research, and G-III Gulfstream for direct astronaut contingency crew return

CREW HEALTH AND SAFETY (CHS)

CHS will continue to collect, maintain, and mine health data related to the long-term effects of space flight in order to mitigate those effects. This data will be useful to ongoing operations and will assist human space exploration activities in defining requirements for assuring safe human space operations for future systems. CHS will also work to implement technologies for monitoring health status before, during, and after flight and assure that medical personnel and crew members are trained to best use those technologies. One of the primary tools utilized will be the lifetime surveillance of astronaut health database, which is an occupational surveillance program for the astronaut corps to screen and monitor astronauts for occupational related disease. The Physician's Compatibility Allowance worksheet in the Supporting Data of this volume provides information on the NASA physicians that support these efforts.

Program Schedule

Astronauts support for ISS missions are detailed on the ISS milestone schedule provided in the ISS section of this volume. Additionally, ISS training infrastructure and mission-specific training for flight and ground crews is generally executed using ISS resources under the auspices of the JSC Mission Operations Directorate, and is not part of the SFCO or CHS budgets.

HUMAN SPACE FLIGHT OPERATIONS (HSFO)

Program Management & Commitments

The SFCO manager reports to the JSC Director. The CHS manager reports to the director of the Space Life Science Directorate at JSC, who reports to the JSC Director. The program is a delegated responsibility from the HEO Mission Directorate.

Project/Element	Provider
SFCO will provide trained astronauts for all U.S. human space flight endeavors and bring experienced astronauts expertise to help resolve operations or development issues.	Provider: SFCO Project Management: SFCO NASA Center: JSC Cost Share: None
CHS will assess and maintain the health of astronauts prior to, during, and post flight.	Provider: CHS Project Management: CHS NASA Center: JSC Cost Share: None

Acquisition Strategy

MAJOR CONTRACTS/AWARDS

Element	Vendor	Location
Aircraft Maintenance and Modification Program	CSC Applied Technologies, LLC	Fort Worth, TX
Bioastronautics Contract	Wyle Integrated Science and Engineering Group	Houston, TX

HUMAN SPACE FLIGHT OPERATIONS (HSFO)

INDEPENDENT REVIEWS

Review Type	Performer	Last Review	Purpose/Outcome	Next Review
Independent Assessment	NRC	Sep-11	Evaluate plans relative to the role and size of SFCO activities following the Space Shuttle retirement and completion of the assembly of the ISS including the astronaut corps' fleet of training aircraft. The NRC conclusions largely reinforced NASA decision making and approach to crew training.	N/A
Performance	Institute of Medicine	Apr-09	This report examines NASA's plans to assemble the available evidence on human health risks of space flight and to move forward in identifying and addressing gaps in research. The committee provided recommendations to strengthen the content, composition, and dissemination of the evidence books.	TBD

LAUNCH SERVICES PROGRAM (LSP)

FY 2013 BUDGET

	Actual	Estimate		Notional			
Budget Authority (in $ millions)	**FY 2011**	**FY 2012**	**FY 2013**	**FY 2014**	**FY 2015**	**FY 2016**	**FY 2017**
FY 2013 President's Budget Request	**83.3**	**81.0**	**81.2**	**82.8**	**82.8**	**82.8**	**82.8**
Change From FY 2012 Estimate	--	--	**0.2**				
Percent Change From FY 2012 Estimate	--	--	**0.2%**				

All ELVs use the same basic technology to get into space: two or more rocket-powered stages that are discarded when their engine burns are complete. Among the Atlas, Taurus, Delta and Pegasus vehicles NASA decides which to use for launch, based on the payload's weight, orbital destination and purpose. Each launch vehicle has a different set of specialties. An Atlas V rocket lofts NASA's Juno planetary probe into space on August 5, 2011.

LSP executes NASA's Expendable Launch Vehicle (ELV) program; the Launch Services Office (LSO) at Headquarters provides strategic guidance and oversight launch of un-crewed robotic payloads. NASA established LSP at KSC for acquisition and program management of ELV missions. A NASA and contractor team is in place to provide leadership, expertise, and cost-effective services in the commercial arena to satisfy Agency-wide space transportation requirements and maximize the opportunity for mission success. LSP provides safe, reliable, cost-effective, and on-schedule processing, mission analysis, spacecraft integration, and launch services for NASA and NASA-sponsored payloads requiring access to space via ELVs.

EXPLANATION OF MAJOR CHANGES FOR FY 2013

The NASA Launch Services (NLS) II contract awarded in September 2010 has a unique on-ramp provision that offers an annual opportunity for both current providers and new entrants to propose new launch vehicle configurations to the indefinite-delivery-indefinite-quantity (IDIQ) contract. In September 2011, LSP modified its NLS II contract with United Launch Services (ULS) of Littleton, CO, doing business as United Launch Alliance (ULA), to add the Delta II rocket launch service in accordance with the contract's on-ramp provision. This modification will enable ULS to offer as many as five Delta II rockets and compete to provide launch services for future NASA missions. Two other on-ramp proposals from other commercial providers for additional launch vehicles are still under evaluation.

LAUNCH SERVICES PROGRAM (LSP)

ACHIEVEMENTS IN FY 2011

In FY 2011, LSP successfully launched three major science payloads: Aquarius, GRAIL, and Juno. Aquarius and GRAIL were launched aboard Delta II launch vehicles: Aquarius from the west coast at Vandenberg Air Force Base, CA, on June 10, and GRAIL from the east coast at Cape Canaveral Air Force Station (CCAFS), FL, on September 10. Juno was launched aboard an Atlas V launch vehicle from CCAFS on August 5. LSP also provided launch related systems engineering, launch integration along with mission design and analysis support to approximately 35 NASA-sponsored missions in various phases of development. LSP and LSO continue to advance objectives to affordably launch CubeSats for both government and academia developers.

In addition, LSO, with the support of LSP, was active on the launch policy front. These efforts resulted in the development and signing of two major agreements with government ELV partners, the U.S. Air Force and the National Reconnaissance Office, that included a memoranda of understanding on Evolved ELV acquisition coordination, and on cooperative investments in launch range infrastructure.

LSO and LSP were active with their support to the Taurus XL T9 Mishap Investigation Board, for the launch failure of the NASA Glory mission. The T9 Mission Investigation Board delivered its final report to NASA in December 2011, and gave a NASA internal briefing to the ELV Flight Planning Board in late January 2012. The report is now going through the Agency's review and endorsement process per NASA Procedural Requirements (NPR) document 8621.1B. Once this step is completed, the appropriate corrective action plan will be developed and implemented.

KEY ACHIEVEMENTS PLANNED FOR FY 2013

LSP has planned four NASA launches in FY 2013 including: IRIS aboard a Pegasus XL; TDRS-K aboard an Atlas V; the Landsat Data Continuity Mission (LDCM) aboard an Atlas V. In addition to the processing, mission analysis, spacecraft integration and launch services of these missions, LSP will also provide advisory support to NASA's LADEE mission, as well as the CRS program in support of ISS, CCDev, and Orion EFT-1 efforts. LSP will continue to provide support for the development and certification of emerging launch providers, which is critical to supporting NASA's future programs. The program will also perform launch related systems engineering, launch integration and mission design and analysis support to approximately 35 NASA-sponsored missions in various phases of development.

Additional information on LSP can be found at:

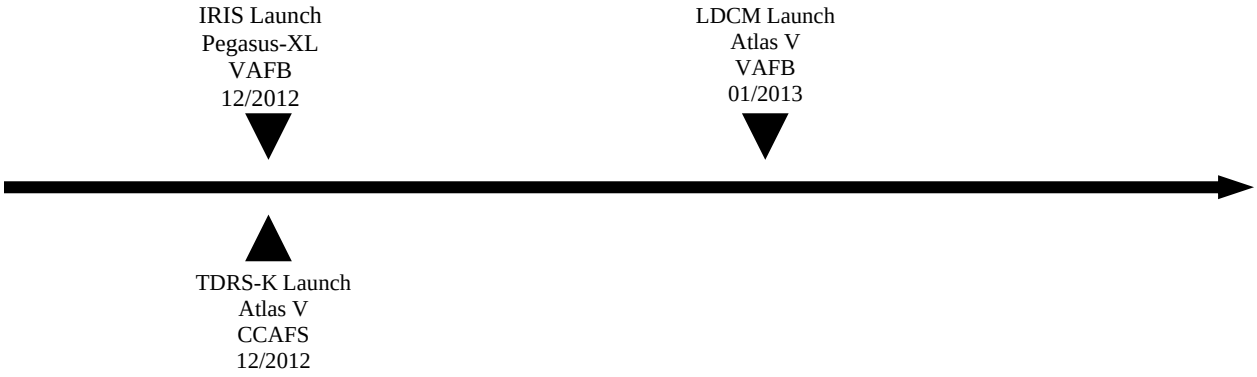
http://www.nasa.gov/directorates/heo/launch_services/index.html
http://www.nasa.gov/centers/kennedy/launchingrockets/index.html

BUDGET EXPLANATION

The FY 2013 request is $81.2 million. This represents a $0.2 million increase from the FY 2012 estimate ($81.0 million). The FY 2013 funding request will support the launch of three NASA missions described in the Key Achievements Planned for FY 2013.

LAUNCH SERVICES PROGRAM (LSP)

Program Schedule



Program Management & Commitments

The LSP Program Manager reports to the Director for Launch Services.

Project/Element	Provider
LSP	Provider: LSP Project Management: LSP NASA Center: KSC Cost Share: None

Acquisition Strategy

The LSP procures ELV launch services from commercial suppliers consistent with the Commercial Space Act. The NLS II contracts are firm-fixed-price IDIQ contracts containing not-to-exceed prices. The ordering period for these contracts expires in June 2020, while the NLS I contract, pre-cursor to the NLS II contract, will remain active until all previously awarded missions under the NLS I contract have launched. The NLS I ordering period expired in June 2010.

Commercial payload processing facilities and services for payloads launching on ELVs from the CCAFS are procured via the east coast payload processing IDIQ contract, which contains not-to-exceed prices. When specific mission requirements are developed, firm-fixed-prices are negotiated. The ordering period for this contract expires in December 2013. A similar IDIQ contract for west coast payload processing services provides payload processing support for missions at VAFB. The basic ordering period for this contract also expires in December 2013.

The ELV Integrated Support (ELVIS) performance-based contract provides administrative, engineering, and mission direct support to the LSP. The contract also provides ELV communications and telemetry

support for operations at KSC CCAFS and VAFB, as well as facility and launch operations support for west coast ELV launches. The LSP Office and KSC procurement recently awarded a new ELVIS 2 contract with a performance period expiring at the end of FY2013.

MAJOR CONTRACTS/AWARDS

Element	Vendor	Location
NLS-L	United Launch Services, LLC	Littleton, CO
NLS-O	Orbital Sciences Corporation	Dulles, VA
NLS-S	Space Exploration Technologies	Hawthorne, CA
NLS-II-A	Lockheed Martin Space Systems	Denver, CO
NLS-II-U	United Launch Services, LLC	Littleton, CO
Payload Processing Facility	Astrotech Corporation	Titusville, FL
Payload Processing Facility	Astrotech Corporation	VAFB, CA
Integrated Processing Facility	Spaceport Systems International	VAFB, CA
ELVIS	Analex Corporation	KSC, FL

Project Risks

The LSP Risk Management Plan is defined in the LSP Program Plan (LSP-PLN-110.01) and implemented in accordance with NASA Policy Directive 8610.7 Launch Services Risk Mitigation Policy for NASA-Owned and/or NASA-Sponsored Payload/Missions; NASA Procedural Requirements 8705.4 "Risk Classification for NASA Payloads" and NPR 7120.5 "NASA Spaceflight Program and Project Management Requirements." The process that conforms to these requirements is outlined in LSP-P-353.01 Launch Services Program Risk Management Process.

The first level of risk management is the classification of the selected launch vehicle for each mission by levels of risk in accordance with NASA Policy Directive 8610.7 and NPR 8705.4, followed by analyzing the probability of occurrence and potential impacts, controlling the process, planning and implementing mitigation strategies, and monitoring the resulting performance. The second level of risk management is the LSP continuous risk management process. This process conforms to the requirements and guidelines defined in NASA Procedural Requirements 7120.5 and is designed to ensure the early exposure and identification of potential problems, enable more efficient use of resources, promote teamwork by involving personnel at all levels of the program, provide information for tradeoffs based on priorities and quantified assessment, and to increase the chance of program success. The NASA Launch Services Manifest is managed and mitigated through quarterly flight planning boards and regular manifest conflict meetings with LSP's customer base. The LSP is also a member of the Current Launch Schedule Review Board comprised of the USAF, DoD, and NASA. The board conducts launch schedule reviews and forecast planning.

LAUNCH SERVICES PROGRAM (LSP)

INDEPENDENT REVIEWS

No reviews planned.

ROCKET PROPULSION TEST (RPT)

FY 2013 BUDGET

Budget Authority (in $ millions)	Actual FY 2011	Estimate FY 2012	FY 2013	Notional FY 2014	FY 2015	FY 2016	FY 2017
FY 2013 President's Budget Request	**44.2**	**43.6**	**45.9**	**45.9**	**45.9**	**45.9**	**45.9**
Change From FY 2012 Estimate	--	--	**2.3**				
Percent Change From FY 2012 Estimate	--	--	**5.3%**				

On Dec. 14, NASA engineers conducted their final J-2X engine test for 2011, the tenth in a series, at the SSC A-2 test stand. The upper stage engine is a key component of the Space Launch System, a new heavy-lift launch vehicle capable of carrying the Orion spacecraft, its crew, cargo, equipment and science experiments to destinations in deep space.

The RPT program represents the single point interface for NASAs rocket propulsion test facilities located at SSC, MSFC, JSCs White Sands Test Facility, and GRCs Plum Brook Station. RPT sustains and improves Agency-wide rocket propulsion test core competencies (both infrastructure and critical skills), ensures that appropriate levels of capability and competency are maintained, and eliminates unwarranted duplication. The program strategy is to fund and maintain core competencies of skilled test and engineering crews and test stand facilities, consolidate and streamline NASAs rocket test infrastructure, establish and maintain world class test facilities, modernize test facility equipment, provide non-project specific equipment and supplies, and develop effective facility/infrastructure maintenance strategies and performance.

The RPT budget does not include resources to support the marginal costs of testing (e.g., direct labor, propellants, materials, program-unique facility modifications, etc.) since programs directly funded these activities when they utilize RPT test stands. When NASA, DoD, and commercial partners use RPT-supported test stands, they are responsible for program-specific facility modifications, in addition to active testing of the program-specific test article.

RPT is the principal implementing authority for NASA's rocket propulsion testing. RPT reviews, approves, and provides direction on rocket propulsion test assignments, capital asset improvements, test facility modernizations and refurbishments. The program integrates multi-site test activities, identifies and protects core capabilities, and develops advanced test technologies.

RPT employs a collaborative approach to ensure rocket propulsion test activities are conducted in a manner that reduces cost, enhances safety, provides credible schedules, achieves technical objectives, and leverages lessons learned. The program reduces propulsion test costs through the safe and efficient utilization of rocket propulsion test facilities in support of NASA programs, commercial partners, and the DoD, while eliminating unwarranted duplication. RPT sustains and improves Agency-wide rocket

ROCKET PROPULSION TEST (RPT)

propulsion test core capabilities (both infrastructure and critical skills) and ensures that appropriate levels of capability and competency are maintained.

The RPT program also represents NASA as a member of the National Rocket Propulsion Test Alliance, an inter-agency alliance between NASA and DoD. The purpose of the alliance is to expand cooperation between agencies and facilitate the efficient and effective utilization of the U.S. government's rocket propulsion test capabilities, as well as coordinate Government rocket propulsion test investments aimed at satisfying the Nation's rocket propulsion developmental and operational testing needs. The RPT Program Manager serves as co-chair of the board.

Additional information on the RPT Program can be found at http://rockettest.nasa.gov/.

EXPLANATION OF MAJOR CHANGES FOR FY 2013

No major changes for FY 2013.

ACHIEVEMENTS IN FY 2011

The test capability portfolio at SSC, MSFC, White Sands Test Facility, and Plum Brook Station have safely and effectively performed over 120 tests in FY 2011, meeting 100 percent of the test goals for NASA, DoD, the Missile Defense Agency, and commercial test customers seeking support from RPT assets. RPT provided support for:

At SSC:

- The Air Force RS-68;
- Orbital Sciences Corporation AJ-26;
- Blue Origin Thrust Chamber Assembly; and
- NASA J-2X.

At JSC-White Sands Test Facility:

- Air Force Minuteman;
- Missile Defense Agency payload integration; and
- Shuttle transition and retirement decontamination testing.

At MSFC:

- Pratt Whitney Rocketdyne component testing.

At Plum Brook Station:

- Wallops Flight Facility and University of Chicago testing.

ROCKET PROPULSION TEST (RPT)

In addition to the active testing schedule, the RPT Program Office enabled consolidation of the SSC test operations contract and the hardware assurance and test contracts into one test operations contract. This consolidation is projected to provide an approximate 20 percent savings of propulsion test costs for programs testing in the SSC facilities.

KEY ACHIEVEMENTS PLANNED FOR FY 2013

In FY 2013, NASA will continue to conduct test facility management, maintenance, sustaining engineering, operations, and facility modernization projects required to keep the test-related facilities in the appropriate state of operational readiness. The program will maximize resources by completing, implementing, and keeping the RPT master plan current, as well as merging current and future requirements, budget resources, and capabilities to assure that NASA maintains a proper propulsion test portfolio. Right-sizing of test infrastructure (both critical skills and facilities) will be implemented within existing budget guidelines to meet all technical, schedule, and cost requirements, both current and future, to include dispositioning facilities that are no longer required. Specific right-sizing activities will be determined in part by a study looking at rocket propulsion test infrastructure and requirements Agency-wide, estimated for completion in spring of 2012. The RPT program will continue to assist in rocket propulsion testing requirements definition for low Earth orbit and in-space propulsion systems and related technologies. RPT will likely generate additional right-sizing activities as test requirements for the SLS program evolve.

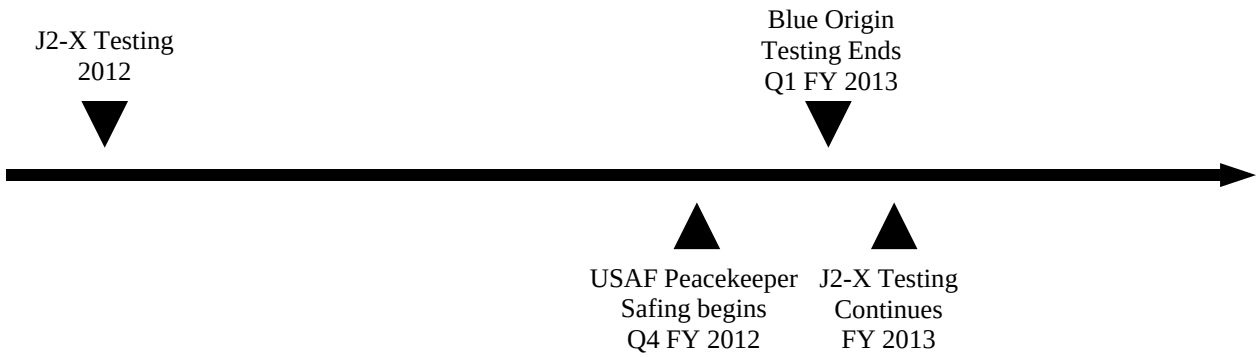
BUDGET EXPLANATION

The FY 2013 request is $45.9 million. This represents a $2.3 million increase from the FY 2012 estimate ($43.6 million). The FY 2013 request includes funding for implementation of White Sands Test Facility right-size activities, which will consolidate test facilities and crew activities for more efficient test operations while maintaining critical infrastructure and skills. These costs to RPT may be reduced as additional test activities for NASA programs, DoD, or commercial customers are scheduled for this test site.

ROCKET PROPULSION TEST (RPT)

Program Schedule

RPT program supports NASA, USAF, and commercial testing.



Program Management & Commitments

The RPT Program Manager reports to the Director of the Human Spaceflight Capabilities Division in the HEO Mission Directorate at NASA Headquarters.

Acquisition Strategy

No major acquisitions are identified for FY 2013. Infrastructure projects identified by RPT will be included in the CECR account request as needed.

INDEPENDENT REVIEWS

No reviews planned.